MARINE BIOLOGICAL LABORATORY.

Received August, 1940

Accession No. 46504

Given by C. V. Mosby Co.

Place, St. Louis, Mo.

*** No book or pamphlet is to be removed from the Laboratory without the permission of the Trustees.

MBL/WHOI
0 0301 0021366 6

MEDICAL MYCOLOGY

MEDICAL MYCOLOGY

FUNGOUS DISEASES OF MEN AND OTHER MAMMALS

BY

CARROLL WILLIAM DODGE, Ph.D.

MYCOLOGIST, MISSOURI BOTANICAL GARDEN; PROFESSOR, HENRY SHAW SCHOOL OF BOTANY,
WASHINGTON UNIVERSITY
ST. LOUIS

ILLUSTRATED

ST. LOUIS
THE C. V. MOSBY COMPANY
1935

MARINE BIOLOGICAL LABORATORY
WOODS HOLE
LIBRARY
MASS.

Copyright, 1935, by The C. V. Mosby Company

(All rights reserved)

Printed in U. S. A.

Press of
The C. V. Mosby Company
St. Louis

TO MY WIFE

WHOSE CONTINUED ENCOURAGEMENT
AND HELP FOR A DECADE HAS MADE
THIS BOOK POSSIBLE

PREFACE

This work was undertaken at the suggestion of the late Professor Roland Thaxter while the writer was a member of the faculty of Harvard University. After a preliminary survey of the literature, a course in Medical Mycology was offered in 1924 and the book has grown out of that course. The manuscript was completed in February, 1932, but unavoidable delays in publishing have prevented its earlier appearance, though it has been used by my classes and research students for several years and has frequently been revised. It contains a summary of all the literature in this field to the end of 1933 except for a few scattered references in relatively rare periodicals which are marked by asterisks in the bibliographies at the ends of the chapters. I have also included all of the references available to me up to July 1, 1934, either at the library of our own Medical School or in the Boston Medical Library, but probably important papers in this period have been missed, as many titles had not found their place in abstracting and indexing journals; work in my own laboratory during this period has been incorporated, even though the papers resulting from the work have not yet been published. During the correction of proofs I do not intend to include any references unless new names or combinations proposed in them affect the nomenclature of species I have already recognized.

For the first time in this field, a relatively complete and accurate bibliography of existing literature is presented. In such a large bibliography, the abbreviation of names of journals presents a serious problem. The code of the League of Nations* was received too late to be followed. If the abbreviation be too brief, it may cause ambiguity to one who is not well acquainted with the journals of a given country or of a given subject, especially when journals have similar names. For example, *Arch. Derm.* might refer to *Archives of Dermatology and Syphilology, Archiv für Dermatologie und Syphilis* or *Archivio Italiano di Dermatologia e Sifilologia.* When *Ann.* is confused with *Arch.,* as is regularly done by the writer of one text in this field, we have also to consider *Annales de Dermatologie et de Syphiligraphie* and the *Anales Dermatologicas y Sifiliograficas.* More rarely we have several journals with the same name, when it is desirable to add the name of the editor, especially if the journals are contemporary. For example, the abbreviation *Jour. Bot.* is almost meaningless. It might refer to the *Journal für die Botanik, Journal de Botanique* (Desvaux), *Journal de Botanique* (Morot), *Journal of Botany* (Hooker) or *Journal of Botany, British and Foreign* (edited successively by Seemann, Triemen, Britten and Rendle, and sometimes cited as *Seemann's Jour.*, etc. In cases where the usual abbreviation would indicate a journal only by the presence or absence of a diacritical mark, I have not abbreviated owing to ease with which diacritical marks are overlooked in proofreading. The number of the series has been given in Roman numerals, the volume number in boldface, and where the pagination is not continuous, the number of the article or part is given in ordinary type between colons.

---

*League of Nations International Institute of Intellectual Cooperation, 1930. International Code of Abbreviations for Titles of Periodicals. 12 pp. and Supplement 18 pp. 1932.

Some care has been taken to ascertain the dates of publications where new species or new combinations are proposed, since this date is the effective one for deciding questions of priority. If it is desirable to record the first isolation of an organism as a matter of historical interest, it should not be connected with the scientific name in bibliographical citations. From bitter experience one learns to disregard the dates given by certain authors, or to add from one to ten years to the dates given. When an author indulges in this practice with reference to his own new species and uses the date of publication or even misquotes the latter in the case of species proposed by others, one cannot help but suspect intentional dishonesty.

Another objectionable practice of some authors is the copying of a bibliography without verifying the citation or reading the article quoted. For example, many authors quote *Robin 1847* when they really mean *Robin 1853.* In Robin's doctoral thesis, *Les vegetaux qui croissent sur les animaux vivants,* viii, 120 pp., 3 pls., Paris, 1847, he uses only the name *Achorion Schoenleini,* although he summarizes the work of previous authors very carefully. When the thesis was reissued in book form under the title *Histoire naturelle des vegetaux parasites qui croissent sur l'homme et sur les animaux vivants,* x, 704 pp., Paris, 1853, with an *Atlas* of 15 plates, the text was greatly expanded and the various organisms were given scientific names. Hence all names attributed to Robin should be cited 1853 not 1847. It follows that when an author cites Robin 1847 for a species name, he is copying without having read the very rare thesis of that date. Such carelessness tends to throw doubt upon an otherwise acceptable piece of work.

It is recognized that errors occur in proofreading, but it is felt that by giving complete bibliographic data as to volume and year, there is little chance that both will show the same typographic errors. The author will be grateful for corrections of errors, for information of the location of references marked with an asterisk or for references to significant work which has been overlooked or to new literature, looking toward a revision.

The chapter on microscopy and staining has been kindly contributed by Dr. Morris Moore and the section on hydrogen ions (pp. 34-38) by my wife. The text-figures have been redrawn from original sources, duly acknowledged in each, by Dr. Gladys Baker, Mr. Albert Heinz, Dr. Morris Moore and the late Mr. Thomas O'Brien, most of those except the yeasts by the latter. The drawings by Dr. Morris Moore are the result of his own research.

While the author assumes full responsibility for the statements of this book, he is grateful to Dr. Margaret B. Church of Urbana University, to Dr. Morris Moore of the Barnard Free Skin and Cancer Hospital of St. Louis, and to Dr. Joseph Swartz of the Medical School of Harvard University for reading the text of the chapters covering their respective fields and for their constructive criticism; to the late Professor Thaxter of Harvard University and to Dr. Charles Thom of the Bureau of Soils for the kind interest and advice they have so generously given; to Mr. James F. Ballard and Miss Lotta McCrea of the Boston Medical Library and to Miss Ella B. Lawrence of the Library of the Washington University School of Medicine for their sympathetic help in finding incorrectly cited references; to many of my former students for helpful suggestions; to the Chancellor of Washington University and to the Director of the Missouri Botanical Garden for a leave of absence to complete reading in the files of rarer periodicals in Boston before beginning my duties in their respective institutions; and to my wife who has helped throughout in the dreary tasks of preparing the manuscript for the printer, correcting the proofs and preparing the index.

—C. W. D.

St. Louis.
August 1, 1935.

MARINE BIOLOGICAL LABORATORY
LIBRARY
WOODS HOLE
MASS.

CONTENTS

CHAPTER — PAGE

I. GENERAL MORPHOLOGY OF FUNGI — 17

Vegetative structures, 17; Reproductive structures, 19; Sexual organs and sexuality, 21; Classification, 24; Bibliography, 25.

II. PHYSIOLOGY OF FUNGI WITH SPECIAL REFERENCE TO REPRODUCTION — 31

Water, 31; Inorganic salts, 32; Carbon, 33; Nitrogen, 33; Hydrogen ion concentration, 34; Oxygen requirements, 38; Temperature requirements, 39; Influence of light, 39; Tropisms, 40; Radium, 40; Bibliography, 40.

III. CULTURE MEDIA, THEIR PREPARATION AND STERILIZATION — 44

Cleaning glassware, 44; Sterilization, chemical methods, 45; Physical agents, 46; Culture media, 48; Liquid media, 49; Solid media, 50; Bibliography, 54.

IV. ISOLATION OF MICROORGANISMS — 57

Transfer, 57; Isolation from skin, 57; Isolation from feces, tongue scrapings, etc., 58; Dilution, 58; Inhibitors, 58; Microcultures, 59; Giant cultures, 60; Single cell cultures, 61; Ascospore detection, 61; Fermentation, 62; Animal and human inoculations and recovery of organisms from lesions, 64; Bibliography, 65.

V. MICROSCOPY (BY MORRIS MOORE) — 66

Mounting media, 66; Spore stains, 67; Stains for fungi in skin, 68; Stains for fungi in other tissues, 68; Stains for hair and scrapings, 69; Stains for sputum, 70; Vital staining of fungi, 70; Fixing agents, 71; Paraffin method, 71; Nitrocellulose method, 71; Bibliography, 73.

VI. BOTANICAL NOMENCLATURE — 75

Historical sketch, 75; International Rules of Botanical Nomenclature, 76.

VII. PHYCOMYCETES — 97
- Mucorales — 97
  - Mucoraceae, morphology — 98
    - *Mucor* Micheli — 110
    - *Absidia* Tieghem — 111
    - *Rhizopus* Ehrenberg — 115
    - *Mortierella* Coemans — 118
  - Bibliography — 119

VIII. ASCOMYCETES — 121

IX. ENDOMYCETALES — 126
- Spermophthoraceae — 127
- Ashbyaceae — 128
  - *Piedraia* Fonseca & Arêa Leão; Piedra of hair — 131
- Pichiaceae — 136
  - *Guilliermondella* Nadson & Krassilnikov — 136

CHAPTER PAGE
Ascoideaceae 137
Endomycetaceae 137
Hansenula Sydow 142
Hanseniospora Zikes 143
Dipodascaceae 145
Actonia Dodge 145
Coccidioideaceae 147
Coccidioides Stiles; Coccidioidal granuloma 147
Rhinosporidium Minchin & Famtham 151
Histoplasma Darling 152
Paracoccidioides Almeida 155
Neogeotrichum O. Magalhães 156
Protomycetaceae 157
Taphrinaceae 159

X. EREMASCACEAE 161
Zymonema Beurmann & Gougerot 165
Oleina Tieghem 179
Octomyces Froilano de Mello & Gonzaga Fernandez 180
Bargellinia Borzi 182
Hemispora Vuillemin 182

XI. EREMASCACEAE IMPERFECTAE 186
Methods of study, 186; Morphology, 190; Classification, 194; Respiratory infections, 204; Thrush, 204; Sprue, 205; Skin infections, 205; Keys, 206.
Proteomyces Moses & Vianna 208
Geotrichum Link 215
Mycoderma Persoon 223
Candida Berkhout 229
Schizoblastosporion Ciferri 234
Pseudomycoderma Will 235
Parendomyces Queyrat & Laroche 238
Castellania Dodge 246
Parasaccharomyces Beurmann & Gougerot 265
Monilia Bonorden 270
Syringospora Quinquaud 272
Blastodendrion Ota 282
Redaellia Ciferri 289
Mycotoruloides Langeron & Talice 290
Mycocandida Langeron & Talice 293
Pseudomonilia Geiger 295
Doubtful position 297

XII. SACCHAROMYCETACEAE 300
Schizosaccharomyces Lindner 307
Debaryomyces Kloecker 308
Saccharomycopsis Schiönning 316
Saccharomyces Meyen 317

XIII. SACCHAROMYCETACEAE IMPERFECTAE 325
Cryptococcus Kuetzing; Torula meningitis 326
Pseudosaccharomyces Laer 341

46504

CHAPTER PAGE

Atelosaccharomyces Beurmann & Gougerot 342
Torulopsis Berlese 347
Eutorula Will 354
Asporomyces Chaborski 356
Microblastosporion Ciferri 357
Trigonopsis Schachner 357

XIV. MALASSEZIA BAILLON; CLINICAL DISCUSSION OF SEBORRHEA AND ACNE 358
Bibliography of Endomycetales 371

XV. PLECTASCALES 425
Gymnoascaceae 425
Ctenomyces Eidam 429
Gymnoascus Eidam 430
Ateleothylax Ota & Langeron 431

XVI. TRICHOPHYTONEAE (GYMNOASCACEAE IMPERFECTAE) 425

Clinical discussion of lesions produced on epidermis, 435; Tinea imbricata, 436; Tinea circinata, 436; Eczema marginatum, 438; Tinea unguium, 440; Lesions of hair and hair follicle, 440; Favus, 441; Tinea tonsurans, 444; Microsporum infections, 444; Trichophyton infections, Sabouraudia type, 445; Malmstenia type, 445; Neoendothrix type, 447; Sycosis, 448; Kerion Celsi, 448; Granuloma of Majocchi, 448; Colony characteristics, 449; Morphology of organisms, 449; Variations and mutants, 455; Pleomorphism, 456; Phylogeny, 457; Classification, 462; Geographic Distribution, 465; Physiology, 466; Therapeusis, 471; Immunology and related phenomena, 474.

Pinoyella Castellani & Chalmers 476
Epidermophyton Sabouraud 477
Endodermophyton Perry 489
Ectotrichophyton Castellani & Chalmers 493
Megatrichophyton Neveu-Lemaire 509
Favotrichophyton Neveu-Lemaire 512
Trichophyton Malmsten 527
Microsporum Gruby 537
Achorion Remak 551
Bibliography 562

XVII. ASPERGILLACEAE 608
Aspergillus Micheli 621
Penicillium Link 639
Paecilomyces Bainier 642
Scopulariopsis Bainier emend. Thom 643
Phaeoscopulariopsis Ota 651
Allescheria Saccardo & Sydow 652
Onygenaceae 653
Bibliography 653

XVIII. FUNGI IMPERFECTI—HYPHOMYCETES 665
Mucedinales 665

XIX. TORULEAE 669
Coniosporium Link 673
Pullularia Berkhout 673

CHAPTER PAGE

Dematium Persoon; Carate or pinta - - - - - - - - - - - - - - 676
Madurella Brumpt; Mycetoma - - - - - - - - - - - - - - 680
Indiella Brumpt - - - - - - - - - - - - - - - - - 685
Bibliography - - - - - - - - - - - - - - - - - - - 687

XX. ACTINOMYCETEAE - - - - - - - - - - - - - - - - - - 694
Morphology, 694; Methods of study, 702; Classification, 703.
Actinomyces Harz - - - - - - - - - - - - - - - - - - 705
Bibliography - - - - - - - - - - - - - - - - - - - 767

XXI. SPOROTRICHIEAE - - - - - - - - - - - - - - - - - - - 786
Aleurisma Link - - - - - - - - - - - - - - - - - - 786
Trichosporium Fries - - - - - - - - - - - - - - - - - 791
Acremonium Link - - - - - - - - - - - - - - - - - - 795
Acremoniella Saccardo - - - - - - - - - - - - - - - 798
Sporotrichum Link; Sporotrichosis - - - - - - - - - - - - 798
Bibliography - - - - - - - - - - - - - - - - - - - 811

XXII. CHALAREAE - - - - - - - - - - - - - - - - - - - 822
Chalara Corda - - - - - - - - - - - - - - - - - - 822
Cephalosporieae - - - - - - - - - - - - - - - - - - 823
Hyalopus Corda - - - - - - - - - - - - - - - - - - 824
Cephalosporium Corda - - - - - - - - - - - - - - - - 826
Corethropsis Corda - - - - - - - - - - - - - - - - - 831
Phialophoreae - - - - - - - - - - - - - - - - - - - 833
Phialophora Thaxter - - - - - - - - - - - - - - - - - 833
Gonatobotrytideae - - - - - - - - - - - - - - - - - - 834
Thomiella Dodge - - - - - - - - - - - - - - - - - - 834
Botrytideae - - - - - - - - - - - - - - - - - - - 835
Acladium Link - - - - - - - - - - - - - - - - - - 836
Monosporium Bonorden - - - - - - - - - - - - - - - - 837
Verticilleae - - - - - - - - - - - - - - - - - - - 841
Spicaria Harz - - - - - - - - - - - - - - - - - - 843
Haplographieae - - - - - - - - - - - - - - - - - - 843
Catenularia Grove - - - - - - - - - - - - - - - - - 843
Haplographium Berkeley & Broome - - - - - - - - - - - - 844
Hormodendron Bonorden - - - - - - - - - - - - - - - - 845
Periconieae - - - - - - - - - - - - - - - - - - - 850
Gomphinaria Preuss - - - - - - - - - - - - - - - - - 850
Hyalodidymeae - - - - - - - - - - - - - - - - - - 851
Diplosporium Link - - - - - - - - - - - - - - - - - 853
Phaeophragmieae - - - - - - - - - - - - - - - - - - 853
Acrothecium Preuss - - - - - - - - - - - - - - - - - 854
Spondylocladium Martius - - - - - - - - - - - - - - - 855
Phaeodictyeae - - - - - - - - - - - - - - - - - - - 856
Alternaria Nees ab Esenbeck - - - - - - - - - - - - - 856
Stilbaceae - - - - - - - - - - - - - - - - - - - 857
Dendrostilbella Höhnel - - - - - - - - - - - - - - - 858
Tilachlidium Preuss - - - - - - - - - - - - - - - - - 858
Tuberculariaceae - - - - - - - - - - - - - - - - - - 858
Fusarium Link - - - - - - - - - - - - - - - - - - 859
Doubtful position - - - - - - - - - - - - - - - - - - 860
Bibliography - - - - - - - - - - - - - - - - - - - 861

ILLUSTRATIONS

FIG. PAGE
1. Hypnospore formation 18
2. Oidial formation 20
3. Coremium 21
4. Sporangia 99
5. Showing the development of the sporangium of *Sporodinia grandis* 100
6. *Blakeslea trispora* 102
7. *Syncephalastrum cinereum* 103
8. *Mortierella niveovelutina* 105
9. Zygospores 106
10. Development of the zygospore of *Sporodinia grandis* 107
11. *Pyronema confluens* 122
12. *Pyronema confluens* 123
13. Spore shapes in the Endomycetales 127
14. *Spermophthora Gossypii* 128
15. *Piedraia Hortai* 129
16. *Eremothecium Gossypii* 130
17. *Nematospora Coryli* 131
18. *Endomyces Magnusii* 138
19. *Endomyces decipiens* 139
20. *Endomycopsis fibuliger* 140
21. *Endomycopsis Lindneri* 141
22. *Dipodascus albidus* 144
23. *Coccidioides immitis* (*Pseudococcidioides Mazzai*) 148
24. *Coccidioides immitis* 150
25. *Rhinosporidium Seeberi* 152
26. *Histoplasma capsulatum* 153
27. *Histoplasma pyriforme* 154
28. *Protomyces macrosporus* 158
29. *Taphrina deformans* 159
30. *Eremascus fertilis* 162
31. *Eremascus albus* 162
32. *Zymonema capsulatum* 163
33. *Zymonema dermatitidis* 164
34. *Oleina nodosa* Tiegh 165
35. *Zymonema Harteri* 178
36. *Hemispora stellata* 183
37. *Hemispora coremiformis* 184
38. *Blastodendrion intermedium* 189
39. Types of blastospores 192
40. Showing Shrewsbury's cell types in *Hansenula* 193
41. *Proteomyces infestans* 209
42. *Proteomyces asteroides* 211
43. *Proteomyces cutaneus* 212
44. *Proteomyces Balzeri* 213
45. *Geotrichum* 216
46. *Geotrichum versiforme* 222
47. *Candida* (*Geotrichoides* Langeron & Talice) 230

FIG. PAGE
48. *Candida Krusei* 232
49. *Monilia* (*Candida* Langeron & Talice) 271
50. *Syringospora* (*Mycotorula* Langeron & Talice) 273
51. *Syringospora* chlamydospores 277
52. *Blastodendrion intermedium* 284
53. *Blastodendrion Pinoyi* 286
54. *Redaellia elegans* Ciferri 289
55. *Mycotoruloides* 290
56. *Mycocandida* 294
57. *Schizosaccharomyces octosporus* 301
58. *Zygosaccharomyces Chevalieri* 301
59. *Torulaspora Rosei* 302
60. *Saccharomyces cerevisiae* 302
61. *Nadsonia fulvescens* 303
62. *Debaryomyces Kloeckeri* 303
63. *Saccharomycodes Ludwigii* 305
64. *Debaryomyces Hudeloi* 310
65. *Debaryomyces Leopoldi* 313
66. *Saccharomycopsis guttulatus* 316
67. *Saccharomyces granulatus* 318
68. *Saccharomyces anginae* 319
69. *Saccharomyces annulatus* 323
70. *Malassezia ovalis* 368
71. *Amauroascus verrucosus* 426
72. *Gymnoascus setosus* (*Eidamella spinosa*) 427
73. *Gymnoascus gypseus and Ctenomyces serratus* 427
74. *Ctenomyces serratus* 428
75. Section through hair from a case of favus, caused by *Achorion Schoenleini* 442
76. Section through hair from a case of tinea tonsurans microsporica, caused by a species of *Microsporum* 444
77. Section through hair from case of tinea tonsurans 447
78. Mycelium 449
79. Nodular organs 450
80. Arthrospores 451
81. Pedicellate chlamydospores 452
82. Intercalary chlamydospores 452
83. Showing closterospores and their transition to chlamydospores 453
84. Aleurospores 454
85. *Endodermophyton Roquettei* 492
86. *Favotrichophyton camerounensis* 516
87. *Microsporum ferrugineum* 546
88. *Aphanoascus cinnabarinus* 609
89. *Monascus ruber* 610
90. Diagrammatic radial sections of colonies 611
91. Diagrammatic radial section of a colony of *Paecilomyces Varioti* 612
92. *Thielavia basicola* 613
93. Types of phialides 614
94. Conidial stages 615
95. *Gliocladium roseum* 616
96. *Penicillium Brefeldianum* 616
97. *Aspergillus nidulans* 617
98. *Penicillium Wortmanni* 618

FIG. PAGE
99. The ascospores of *Aspergillus* 620
100. *Aspergillus Amstelodami* 631
101. *Aspergillus Jeanselmei* 638
102. *Penicillium Bertai* 640
103. *Paecilomyces Varioti* 643
104. *Scopulariopsis brevicaulis* (Sacc.) Bainier 644
105. *Alternaria* sp. 666
106. *Hormiscium stilbosporum* Corda and *Hormiscium pinophilum* Nees 672
107. *Pullularia Jeanselmei* 675
108. *Dematium articulatum* Pers. 676
109. *Dematium hispidulum* 677
110. *Madurella mycetomi* 680
111. *Indiella Mansoni* 686
112. *Actinomyces II* isolated from soil 696
113. *Actinomyces XVIII* 698
114. *Actinomyces albus* (*A. griseus* Krainsky?) 699
115. *Actinomyces XVIII* 700
116. *Actinomyces aureaus* 701
117. *Actinomyces Lavendulae* 702
118. *Actinomyces scabies* (Thaxter) Güssow 704
119. *Acremonium alternatum* Link 796
120. *Acremonium Potronii* Vuillemin 797
121. *Rhinocladium coprogenum* Saccardo & Marchal 800
122. *Sporotrichum Schenki* var. *Beurmanni* 807
123. *Sporotrichum Lesnei* Vuillemin 810
124. *Thielaviopsis paradoxa* 823
125. *Chalara fusidioides* Corda 823
126. *Hyalopus muscorum* Corda 825
127. *Cephalosporium Acremonium* Corda 827
128. *Corethropsis paradoxa* Corda 832
129. *Phialophora verrucosa* Thaxter in Medlar 833
130. *Acladium conspersum* Link 836
131. *Acladium Castellanii* 836
132. *Monosporium spinosum* Bonorden 838
133. *Monosporium apiospermum* Saccardo 839
134. *Verticillium agaricinum* (Link) Corda 842
135. *Haplographium chlorocephalum* (Fresenius) Grove 844
136. *Hormodendron olivaceum* Corda 846
137. *Hormodendron Fontoynonti* 847
138. *Gomphinaria Pedrosoi* 851
139. *Arthrobotrys superba* Corda 852
140. *Trichothecium roseum* Link 852
141. *Diplosporium vaginae* 854
142. *Acrothecium nigrum* 855

MEDICAL MYCOLOGY

CHAPTER I

GENERAL MORPHOLOGY OF FUNGI

The Fungi form a large heterogeneous group of plants, including all those lacking chlorophyll, which are not closely nor obviously related to other groups. In a few primitive families, the vegetative body is naked and amoeboid. In the rest of the fungi, it is surrounded by cell walls and usually appears as septate filaments, called **hyphae.** The vegetative hyphae are collectively known as **mycelium.** Under certain conditions of nutrition, as in solutions of very high or of very low osmotic pressure, the hypha grows by sprouting, when a small protuberance enlarges, rounds off and is abjointed (cut off by a septum) from the mother cell. The daughter cell, called sprout cell or **blastospore,** continues to increase in size and eventually separates from the original group of cells. In certain groups, as in the yeasts, no other type of vegetative body is known. When conditions for growth are unfavorable, the protoplasm contracts, rounds up and secretes a special thick wall, forming resting cells, called **hypnospores** or **chlamydospores.** (Fig. 1.) With the return of favorable environmental conditions, these hypnospores again develop normal vegetative mycelium.

In a few groups of fungi, the hyphal wall gives the cellulose reaction, in most others that of chitin. In fructifications and resting cells, the hyphal wall first appears as a thin, hyaline membrane which becomes thicker and may be further differentiated by secretions and deposits of minerals or resins, or colored by pigments. A relation between the fundaments of the wall and mitosis has been demonstrated in only a few cases, as in ascospore formation. In general, the wall is gradually differentiated from the cytoplasm without nuclear aid. The septum often forms by furrowing (annular thickening of the walls, like an iris diaphragm in a camera). For the maintenance of intercellular communication, the septa are frequently pierced by a few openings through which pass protoplasmic threads.

During rapid growth, there may be a delay in the formation of septa, later compensated by simultaneous or successive development of septa. In the Phycomycetes, the septa are wholly suppressed; the whole mycelium is then a single, branched, multinuclear mass of filaments, becoming septate during the formation of reproductive organs, or during conditions of poor nutrition or of senescence.

The individual hyphae generally are intertwined in feltlike masses. Such a group of hyphae, called the mycelium, usually absorbs food at any point over its whole surface. Small mycelial branches, which serve to attach the mycelium to the substrate and to absorb the nutrients, have become specialized in form and function in several groups. When the absorbing organs are rootlike, filamentous, finely branched and tapering, they are called **rhizoids** (frequent in the Chytridiales). When they are intracellular, clavate, bluntly lobed, coarsely branched or coralloid organs of parasites which do not immediately injure or kill the host cell, they are referred to as **haustoria** (frequent in plant parasites). When the function seems to be purely one of attachment and the mycelial branches are flattened and disciform, bluntly lobed or branched, or even coarsely filamentous, they are called **holdfasts** (e.g., *Rhizopus* of the Mucorales). **Appressoria** are holdfasts which are superficial or nonpenetrating, although they may be intercellular (frequent in the sooty molds). In many cases, the hyphae grow together in groups, intertwine, adhere, and form a thick tissue, called **plectenchyma.** If the single hyphal elements are

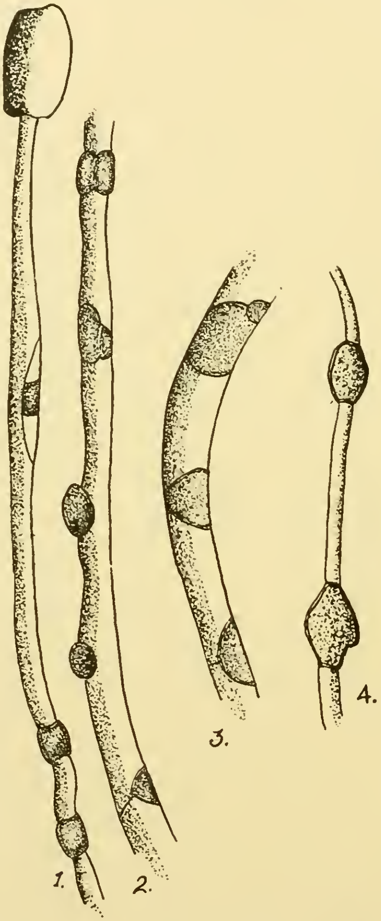

Fig. 1.—Hypnospore formation in *1; 2, Mucor racemosus; 3, M. dimorphosporus; 4, Rhizopus arrhizus.* (After Lendner 1908.)

still recognizable as such, they are referred to as **prosenchyma**; if the hyphae have lost their individuality so that they lie adjacent, with the cells (in sections of the tissue) appearing isodiametric and continuous, they are called **pseudoparenchyma** since they are formed by cell division in a single plane while the parenchyma of higher plants develops from cell division in three planes.

Sclerotia are small hard masses of plectenchyma with a firmer pseudoparenchymatic rind and a looser prosenchymatic core. These structures serve to carry the organism over unfavorable environmental conditions and, with the return of normal conditions, germinate to the usual mycelium or to a fructification. Sclerotia are formed on drying out of the culture in many species of *Aspergillus*. **Bulbils** are small sclerotia formed of a few layers of cells and are often present in large numbers. The grains in the lesions of mycetomas (Madura foot, etc.) belong in this general category.

Reproductive Structures.—In most fungi, at a definite age and under favorable conditions of nutrition, reproductive structures develop on the mycelium. The products of the reproductive processes are chiefly spores. **Spores** may be defined as characteristically formed cells or groups of cells which separate from the mother plant and may grow independently to new individuals. They serve either for propagation (multiplication and dispersal) or for resisting unfavorable conditions of the environment (prolonged desiccation, overwintering, etc.). Spores specialized for the latter function are often called **hypnospores** (Fig. 1).

In the simplest case, hyphal cells separate from the parent hyphae and develop into new hyphae. These individual cells are called **arthrospores** or thallospores and are homologous with the cells of a chain of blastospores, though the latter arise by sprouting rather than by the breaking apart of the cells of a hypha (Fig. 2).

From arthrospores there is a gradual transition to more typical spores with characteristic color, form, and sculpturing of the wall. In many cases they are abjointed directly from the cells of an ordinary hypha; in other cases they arise on specialized sporophores. Where these sporophores form the spores within specialized sporogenous cells, **sporangia,** they are called **sporangiophores** and the spores, if they are enclosed and nonmotile, **sporangiospores** (e.g., in the Mucorales). Sporophores which abjoint their spores exogenously at their tips are referred to as **conidiophores** and their spores **conidia** (e.g., in the Fungi Imperfecti). A **chlamydospore** is any thick-walled asexual spore without further regard to its morphologic significance.

In the higher fungi, the mycelium surrounding a group of conidiophores (or sexual organs) is known as a **fructification.** When these groups are in fascicles, they are called **coremia** (Fig. 3); if they form widespread cushions, they are called **sporodochia** (Tuberculariaceae) or **acervuli.** The tissue from which they arise is then known as their **stroma.** When the conidiophores develop in cavities in the stroma, the fructifications are called **pycnia,** and the conidia are often called **pycnospores** or stylospores. These different spore forms, blastospores, arthrospores, chlamydospores, conidia, etc., usually develop on the haplont (thallus of the haploid stage of the life cycle). A single species which successively produces several spore forms is called **polymorphic.**

The spores of a second type are connected with sexuality and develop after fertilization or meiosis in the spore mother cell. These changes are connected respectively with the beginning or the end of the diploid phase. The spore forms following fertilization are recognizable morphologically since they are encysted **zygotes** (the products of a sexual act); biologically they usually develop as hypnospores or resting spores (e.g., the zygospores of the Mucoraceae).

The spore forms which follow meiosis are morphologically recognizable because they form **tetracytes** (as daughter cells of **gonotoconts,** the organs in which meiosis occurs). Apparently, since they are products of meiosis, they have become constant in number, usually 8 (in the Ascomycetes) or 4 (in the Basidiomycetes); biologically they are also hypnospores in the higher fungi. When the sporogenous cells which serve as gonotoconts form their spores internally through free cell formation, they are called **asci** and their spores **ascospores** (whence the term Ascomycetes). When the spores are cut off externally from the gonotoconts, they are called **basidiospores** and the sporogenous cells **basidia** (whence the term Basidiomycetes, the saprophytic mushrooms, puffballs, etc., and the parasitic rusts and smuts).

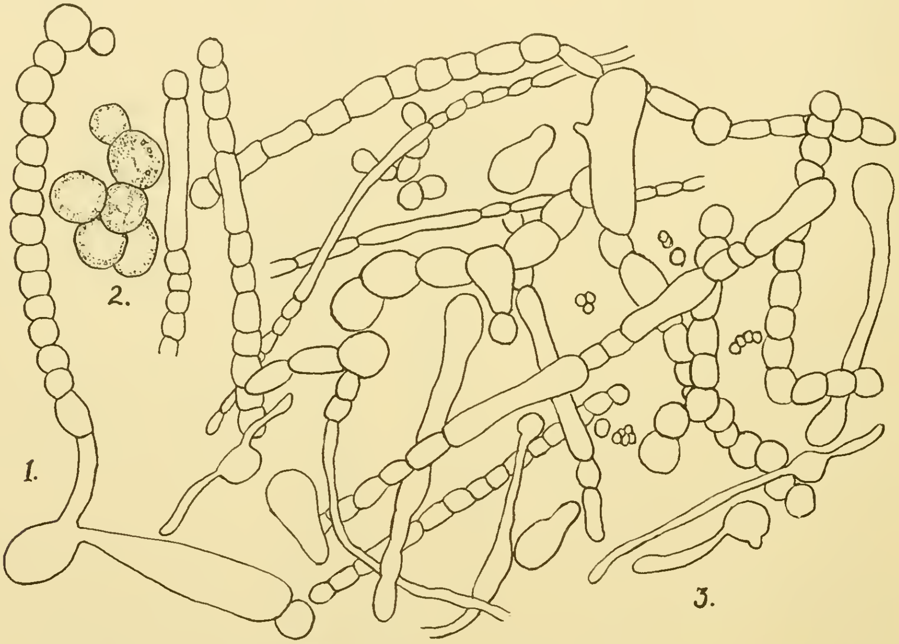

Fig. 2.—Oidial formation in *1; 2, Mucor racemosus; 3, Mucor Prainii.* (After Chodat, *Principes de Botanique.*)

As the conidiophores of the haplont, these gonotoconts are usually grouped in a superficial layer of tissue, known as a **hymenium.** This tissue generally develops on a fructification whose structure is highly differentiated. In the higher groups, the fructifications containing the gonotoconts become visible to the naked eye and are called the **perfect** forms. The other spore forms are referred to as **imperfect** or secondary spore forms.

Sexual Organs and Sexuality.—The sexual function in its simplest stage involves but two processes: (a) **fertilization,** a fusion of two nuclei, recurring periodically in the course of development, initiating specific stimuli for further development; and (b) **meiosis,** a return to the single chromosome number. This rotation (haplont → fertilization → diplont → meiosis →) comprises the changes of nuclear condition in most organisms. A few fungi seem to exist without such a change; they seem to live an unlimited number of "generations" without reconstruction of their nuclei and to propagate themselves by imperfect stages only. Such fungi with incomplete, or incompletely known life cycles are called **Fungi Imperfecti.**

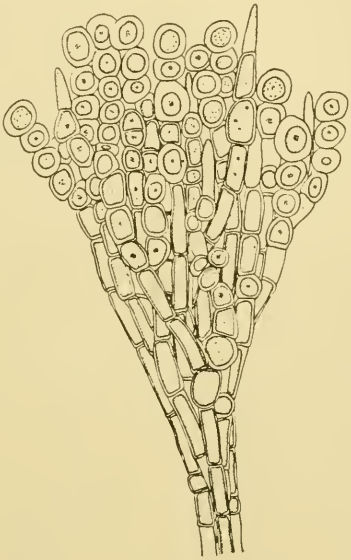

Fig. 3.—Coremium. *Hemispora coremiformis.* (After M. Moore 1935.)

The fungi with complete life cycles are divided into homothallic (hermaphroditic) and heterothallic forms. In contrast to the higher plants and animals, the division of sexes is here limited to the haplont, i.e., the mycelium. The homothallic form is often indicated by the symbol ±, the heterothallic forms as + or –. The + and – mycelia of the latter group may be distinguished from each other only physiologically, as indicated by their sexual tendencies, or morphologically as well (e.g., in growth form, sexual dimorphism).

Fertilization in fungi, as in protozoa, may occur in many ways. The simplest normal type of fertilization, when two spatially separated, not closely related sexual cells fuse to form a new entity, is called **amphimixis.**

If the sexual cells arise as daughter cells of a differentiated mother cell and are themselves characteristically formed, they are called **gametes** and the mother cells **gametangia**. The copulation of two gametes of this type is called **merogamy**. If the gametes appear wholly of the same size and shape, the copulation is **isogamous**; if the gametes are differentiated, their copulation is **heterogamous** (anisogamous). When the female gamete is a large and nonmotile egg and the male gamete is a small and motile sperm, their copulation is **oogamous**, a condition confined to primitive fungi, although present in most higher animals and primitive plant phyla.

The more advanced fungi show various stages in the degeneration of merogamy. At a comparatively low stage, the differentiation of gametes is suppressed and the contents of the gametangia remain polyenergid. Thus the original copulation of gametes disappears, being replaced by many secondary processes which compensate for the loss of the original merogamy. All these secondary processes are classified as **deuterogamy**. The higher algae and flowering plants have also developed these processes, while the primitive merogamy has persisted through the highest vertebrates.

In deuterogamy, the gametangia assume the function of their daughter cells, the gametes, and their coenocytic content fuses without further differentiation. The sexual act occurs between two sexual organs instead of between two sexual cells and sexual attraction passes from the latter to the former. This type of copulation is called **gametangial**. It assumes close contact between two gametangia and has a biologically obvious consequence that one gametangium can fertilize only one other which must be located nearby; it has the advantage that the fusion of gametes is no longer fortuitous, since the gametangia provide that their nuclei can come into contact and fuse. Thus gametangial copulation is an efficient type, since most of the nuclei of both gametangia succeed in their activity with an increase in the number of zygote nuclei. The fate of the gametangium hangs upon the occurrence or nonoccurrence of a single sexual act, from which results one single, very strong, coenocytic zygote instead of many smaller unicellular zygotes. Also a single mature gametangium no longer depends on a definite medium (e.g., water) for the copulation of its gametes, a condition which has facilitated the transition from water to land habitats and to parasitism. Whether gametangia are borne on specialized branches or whether hyphal branches as a whole complete the act of fertilization, they are called **copulation branches**. When sexual dimorphism is present, the male is called an **antheridium** and the female an **ascogonium**.

Among the higher Ascomycetes, the fundaments of the antheridium are gradually reduced, whereby cross-fertilization generally ceases and is replaced by self-fertilization, i.e., a new group of deuterogamous processes, between daughter cells of the same mother cell or between nuclei of the same cell, which are included in the term **automixis**.

Automixis is represented in fungi by two forms: parthenogamy and autogamy. **Parthenogamy** is fertilization which occurs between two female cells, i.e., in fungi usually between two cells of the ascogonium. In some groups this parthenogamic fusion of two specialized cells is replaced by the pairing of nuclei within a single multinucleate cell of the ascogonium. This automictic fertilization within a cell is called **autogamy.**

From these forms in which the sexual organs (or in any case the female organ) are apparently typical in form but no longer functional and serving only as a site of automictic processes, there is a series of intermediate stages to the other extreme where the sexual organs disappear entirely, the sexual processes occurring in the mycelium between any two sexually differentiated cells. The latter process is called **pseudomixis.** Since the copulating cells are not morphologically distinguishable from other vegetative cells and since only the release of specific developmental stimuli marks this anastomosis of two vegetative cells as a sexual process, pseudogamy is often difficult to distinguish from the usual pseudosexual anastomoses which are brought about by food relations. Its true character is recognizable cytologically only in the pairing of nuclei. If pseudogamy occurs between two sprout cells, they are sometimes wrongly called gametes. In order to avoid misunderstanding, this term should be reserved for merogamous gametes. The ambiguous term **pedogamy,** often employed in other senses, should be used to indicate pseudogamy between adult and young cells. The special case of pseudogamy between mother and daughter cell is called **adelphogamy.**

Apomixis, the entire loss of fertilization, represents the last step in this series of reduction of sexuality where growth from reproductive cells occurs vegetatively without cell or nuclear fusion, or any external stimulus of development. If the new individual (in the absence of fertilization) arises from haploid sexual cells, the process is called **parthenogenesis**; if they arise (in the absence of meiosis) from diploid sexual cells, the process is called **apogamy.**

In the study of fungi, there is the further difficulty that the original processes of fertilization are replaced by all sorts of substitutes. Among the lower fungi, there is simple fertilization when a fusion of the cytoplasm of two sexual cells **(plasmogamy)** is immediately followed by a fusion of both haploid nuclei into a diploid zygote nucleus, a **syncaryon (caryogamy).** In most fungi, however, caryogamy is delayed and is only completed just before meiosis. Thus the sexual haploid nuclei, while remaining spatially separate, unite only to form a **dicaryon,** where the paired nuclei divide synchronously (conjugately) while retaining the same ability to activate somatic development as after complete caryogamy. This phenomenon is analogous to that in *Cyclops,* in which the parent chromosomes remain distinct up to the time of egg formation (synapsis) although they are surrounded by the same nuclear membrane, whereas in the fungi they remain within their original nuclear membranes.

In this retardation of caryogamy, the binucleate "zygote" continues its growth without completing nuclear fusion, developing a new mycelium whose cells, morphologically virtually diploid, contain two sexually differentiated haploid nuclei. This new phase, intruded between plasmogamy and caryogamy, is called the **binucleate phase.** In the Ascomycetes, this phase is mostly limited to the ascogenous hyphae and the hymenium of the fructification, but in the Basidiomycetes, it is usually the most conspicuous phase of the life cycle.

In spite of this removal and retardation, caryogamy always occurs in definite organs. The organs in which the fertilization processes are completed and the dicaryon ends are called **zeugites.** As caryogamy is delayed until the necessity for meiosis appears, the zeugites also frequently function as gonotoconts. These two processes, the transformation of the cells which complete the sexual act and the division of the sexual act itself into plasmogamy and caryogamy, separated in time and space, are both fundamental and very useful in the study of phylogeny and classification.

In the present state of our knowledge, the various groups of fungi are apparently polyphyletic and unrelated. Some members seem more closely related to other groups of plants than to other groups of fungi; e.g., the Chlamydobacteriales and perhaps the Thiobacteriales seem more closely related to the Myxophyceae than they are to other groups of bacteria or of fungi.

The following list of classes of fungi illustrates the main subdivisions while not necessarily assuming that all the fungi of these larger groups are monophyletic. In time some of these groups will probably be further divided, e.g., the Phycomycetes seem quite heterogeneous. For our purposes, however, only one order of these, the Mucorales, has been shown to have members attacking man and other mammals, and needs consideration here.

Schizomycetes: bacteria in the larger sense.

Myxomycetes: slime molds, having many resemblances to Protozoa in some stages of their life cycle.

Phycomycetes: coenocytic fungi of varied origin and relationship.

Ascomycetes: a large polymorphic group with a common method of spore formation in asci.

Basidiomycetes: a very large group with spores borne on a specialized gonotocont, the basidium, furnishing most of the conspicuous fungi.

Fungi Imperfecti: a heterogeneous group whose life cycles are unknown in full, or which have degenerated until sexuality has been lost, provisionally grouped together until they are better known.

Schizomycetes.—*Bacteria.* While this group is by far the most important from the standpoint of the physician and the surgeon, it is also the best known to the medical profession and will not be given further consideration here. The bacteria seem almost wholly unrelated to the other groups of fungi, and some of the higher forms are suggestive of Myxophyceae which have lost their chlorophyll.

Myxomycetes.—The slime molds are a very interesting group with many stages suggestive of similar conditions found in the Protozoa, especially the Rhizopoda, while other stages are analogous to those in other groups of fungi. The stages commonly observed being plantlike, they have been studied mostly by botanists and only in the last decade has any long continued or thorough attempt been made to follow the life cycle in detail or to study the cytology. At present the group is known to cause plant diseases but has not been suggested in relation to animal disease. Any related organisms attacking man have undoubtedly been studied and classified as Protozoa.

Phycomycetes.—This group in its more primitive members seems distantly related to the Flagellata of the Protozoa. Most of the members have a vegetative body of mycelium and in all but one order reproduce by a flagellated body. Most of the group are saprophytes or parasites on plants except a few facultative parasites of fish or invertebrates. The only group at present known to produce human parasites is the Mucorales which will be treated later in the appropriate chapter.

Ascomycetes.—The more primitive members show distant relationships to the higher Phycomycetes on the one hand and to the Rhodophyceae (Red Algae) on the other. After a half century of bitter controversy on this question, there is still little agreement. Here the vegetative body is a typically uninucleate, septate mycelium and sexual reproduction occurs by means of cells produced within an ascus, following meiosis in all forms where this has been carefully studied. Of the twenty orders into which this group is usually divided, members of only two, the most aberrant and primitive (or degenerate), have been shown to cause human disease. The bulk of the group are saprophytes or parasites of the leaves and bark of plants, while the most highly specialized (Laboulbeniales) are at present known only as parasites of living insects.

Basidiomycetes.—While the life cycle shows a certain parallelism to that of the higher Phycomycetes and the Ascomycetes, it is difficult to assign to these any very close relationship with other groups. The vegetative body again consists of uninucleate or binucleate mycelium, forming a conspicuous fructification on which the reproductive structures are borne. Reproduction occurs by means of basidiospores. So far as is known the group is saprophytic on decaying vegetable matter in the conspicuous species, such as the mushrooms, punks, puffballs, etc., or parasitic, usually on leaves, in the Uredinales (rusts) and Ustilaginales (smuts).

Fungi Imperfecti.—These are a large group, artificially classified together while we await more knowledge of their life history. The greater part, whose life history has been discovered, has been found to be Ascomycetes, but it is never safe to predict that several members of a given genus of Fungi Imperfecti will necessarily belong to the same genus of Ascomycetes or even will be Ascomycetes; e.g., when *Oedocephalum* was carefully studied, one species was found to be a Phycomycete, another an Ascomycete, and a third a Basidiomycete. Various subdivisions have been proposed, but none has proved altogether satisfactory. Further considerations may well be delayed to a subsequent chapter (p. 665).

In the following chapters only those orders will be discussed in which mammalian pathogens have been found, and the reader is referred to Gäumann and Dodge (1928) for information on other groups.

BIBLIOGRAPHY

The following bibliography includes references to early work in which it is difficult or impossible to be sure of the group of fungi involved, also general review articles, textbooks, etc., covering most of the groups of human pathogenic fungi. These have not been repeated in the bibliographies of the individual groups, even though they often contain as much information about a single group as do the references given for that group. Asterisks (*) denote that I have not read the reference in question, but it is quoted from a fairly reliable author or abstracting journal. I have not tried to quote any references from certain writers whose references are notoriously incorrect, often showing errors in over half the titles of a short bibliography.

Agostini, Angela. 1934. Miceti della Somalia, *Atti Ist. Bot. R. Univ. Pavia* IV, 4: 191-201, *4 fig.*

Bail. 1867. Ueber krankheitenerzeugende Pilze, *Wiener Med. Woch.* 17: col. 977-979; 993-996.

Baillon, H. 1889. Traité de botanique médicale cryptogamique, Paris, 376 pp. [see pp. 246-249].

Baumgarten, Paul Clemens. 1884. Ueber pathogene pflanzliche Mikroorganismen. I, *Deutsch. Med. Zeitschr.* 1884^1: 149, 150; 163-165; 175-178; II. Die pathogenen Schizomyceten, *Ibid.* 1884^2: 169-173; 181-185; 193-197; 205-208.

—. 1890. Lehrbuch der pathologischen Mykologie. Vorlesungen für Ärzte und Studierende. Harald Bruhn; Braunschweig, IX, 973 pp., *1 pl., 101 figs.*

Beurmann, Lucien de. 1912. Les nouvelles mycoses, exoascoses (ex-blastomycoses) oidiomycoses, sporotrichoses, botrytimycose, oosporose, hemisporose, Paris, Masson & Cie. 165 pp.

Beurmann, L. de & H. Gougerot. 1909. Les Exascoses, endomycoses, et parendomycoses (Muguet) saccharomycoses (mycose de Busse-Buschke) et parasaccharomycoses. Zymonematoses (Mycose de Gilchrist) Révision et démembrement de l'ancien groupe des Blastomycoses, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 28: 222-246; 250-263.

—. 1912. L'état actuel de la question des mycoses, *Biol. Méd.* 10: 133-166; 187-222, *18 figs.*

Bianchini, Giuseppe & G. Paolo Manfrini. 1924. La micologia del cadavere umano nei rispetti della cronologia della morte e delle trasformazioni tanatologiche, *Atti R. Accad. Fisiocrit. Siena* IX, 16: 335-351, *8 figs.*

Blanchard, Raphael. 1896. Parasites végétaux à l'exclusion des bactéries, in Bouchard, Charles. Traité de pathologie générale 2: 811-926.

—. 1899. Sur une affection causée par les spores d'un champignon parasite du roseau ou canne de Provence (Arundo donax L.), *Arch. de Parasitol.* 1: 503-512.

Bodin, E. 1902. Les champignons parasites de l'homme, Paris, Masson et Cie, 208 pp.

Brocq Rousseu. 1921. Les recherches mycologiques en médécine vétérinaire, *Bull. Soc. Myc. France* 37: 99-103.

Brooke, Gilbert E. 1908. Aids to tropical medicine, New York, William E. Wood, 163 pp.

Brumpt, E. 1927. Précis de parasitologie. 4 ed. Paris, Masson & Cie, viii, 1452 pp., *5 pls.*

Castellani, Aldo. 1912. Note on the importance of Hyphomycetes and other fungi in tropical pathology, *Brit. Med. Jour.* 2: 1208-1212.

—. 1917. Notes on tropical diseases met with in the Balcanic and Adriatic zones, *Jour. Trop. Med. Hyg.* 20: 157-164; 170-174; 181-186; 198-202; 209-214; 219-223.

—. 1918. Alcune osservazioni sulla malaria e su altre malattie tropicali della zona Balcanico-Adriatico, *Ann. Med. Nav.* 24^1: 169-213.

—. 1920. Higher fungi and human pathology, *Lancet,* 198: 847-852, 895-901, 943-946 [also reprinted in *Jour. Trop. Med. Hyg.* 23: 101-110, 117-125, 132-138].

—. 1923. Medical mycology, *Brit. Med. Jour.* 2: 937-1041 [also reprinted *Jour. Trop. Med. Hyg.* 27: 49-53, 61-65, 1924].

—. 1924. Tropical Dermatology, *Int. Conf. Health Problems of Trop. Amer.* [United Fruit Co.] 485-499.

—. 1925. Observations on some diseases of Central America, *Jour. Trop. Med. Hyg.* 28: 1-14, *31 figs.*

—. 1926. Chronic bronchites with hemorrhagic sputum of nontubercular origin, *N. Orleans Med. Surg. Jour.* 79: 20-42.

—. 1927. Notes on certain bronchomycoses which may simulate pulmonary tuberculosis, *Am. Rev. Tuberculosis* 16: 541-574.

—. 1927-1928. Fungi and fungous diseases, *Arch. Derm. Syphilol.* 16: 383-425; 571-604; 714-740, 1927; 17: 61-97; 194-220; 354-379; 1928 [reprinted Chicago, Amer. Med. Assn. 203 pp., *44 figs.* 1928].

Castellani, Aldo & Albert J. Chalmers. 1910-1919. Manual of tropical medicine, New York, William Wood & Co., XXV + 1243 pp.; ed. 2, XXXII + 1747 pp., *16 pls., 909 figs.*, 1913; ed. 3, X + 2436 pp., *16 pls., 909 figs.*, 1919.

Castellani, Aldo, MacKenzie Douglas, & J. Thomson. 1923. Further observations on tonsillomycoses, *Jour. Trop. Med. Hyg.* 26: 19-24.

Castellani, Aldo, & Henri Tejera. 1923. Notes on the etiology of ''cute,'' *Jour. Trop. Med. Hyg.* 26: 183, 184.

Cavara, V. 1928. Le micosi oculari, Siena, 494 pp.

Chiurco, Giorgio Alberto. 1922. Simbiosi tra ifomiceti patogeni e schizomiceti, *Riv. Biol.* 4: 684-688.

*—. 1922. Simbiosi tra ifomiceti patogeni e schizomiceti, in rapporto al loro potere patogeno, *Ist. Bot. R. Univ. Siena,* 75 pp.

—. 1923. Micosi chirurgiche sperimentali, *Pathologica.* 15: 487, 488.

—. 1925. Esperience nelle cavità articolari tessuto muscolaree cutaneo dei ratti e delle cavie in rapporto alla simbiosi ifoschizomicetica, II, *Atti R. Accad. Fisiocrit. Siena* IX, 16: 171-207, *Pls.* 1, 2.

—. 1927. Experimentell hervorgerufene mykotische Arthritiden und Myositiden, *Derm. Woch.* 84: 228-232.

Coupin, Henri. 1909. Atlas des champignons pathogènes de l'homme et des animaux. 58 planches renfermant 1000 dessins reproduits d'après les travaux originaux, Paris, Octave Doin et Fils.

Dubreuilh, William. 1891. Des moisissures parasitaires de l'homme et des animaux supérieurs, *Arch. Méd. Exp. Anat. Path.* 3: 428-447, 566-592.

Durante, G. 1927. Les mycoses méconnues, *Bull. Mém. Soc. Méd. Hôp. Paris* [51]: 1513-1516.

Fairman, Ch. E. 1920. The ascomycetous fungi of human excreta, Lyndonville, N. Y., 11 pp., *3 figs, 1 table.*

Fleisher, M. S., & M. Wachowiak. 1924. The relation of fungi imperfecti to diarrhoeal conditions, *Am. Jour. Med. Sci.* 168: 371-380.

Fonseca filho, Olympio Oliveira Ribeiro da. 1928. Algumas consideraçoes de ordem geral sobre as dermatomycoses, *Sciencia Med.* 6: 565-569.

—. 1929. As mycoses na clinica dermatologica e syphilographica da faculdade de Medicina do Rio de Janeiro, *Rev. Med. Cirurg. Brasil.* 37: 126-128.

—. 1929. Notas sobre os exames de laboratorio na pesquiza e diagnostico das mycoses, *Rev. Med. Cirurg. Brasil.* 37: 169-179.

Frescoln, L. D. 1916. Mycology as a part of practical dermatology, *Internat. Clin.* 2: 170-172, 1 col. *pl.*

Frey, Ludwig. 1888. II. Fungus articulat. talo-calcaneae. Injection con Jodoformäther Heilung und vollkommene Wiederherstellung der Functionsfähigkeit, *Wiener Med. Presse.* 29: col. 1325, 1326.

Fürbringer, Paul. 1876. Beobachtungen über Lungenmykose beim Menschen, *Arch. Path. Anat. Physiol.* [Virchow] 66: 330-365, *Pl. 15.*

Gäumann, Ernst A., & Carroll William Dodge. 1928. Comparative morphology of fungi, New York, McGraw Hill Book Co., 701 pp., *398 figs.*

Gautier, L. 1907. Recherches biologiques sur quelques champignons parasites de l'homme et des animaux (diastases & toxines), Brest, P. Gadreau, 149 pp.

Gedoelst, L. 1902. Les champignons parasites de l'homme et des animaux domestiques, Bruxelles, 199 pp., *124 figs.*

Grazia, Francesco de. 1903. I microorganismi dei polmoni dei Cardiaci, *Rif. Med.* **19**: 709-713.

Greco, Nicolas V. 1916. Origine des tumeurs (étiologie du cancre) et observations de mycoses (blastomycoses, etc.) Argentines, La Semana Médica: Buenos Ayres. VI + 853 pp., *29 pls., 492 figs.*

Greenwood, Arthur M. & Joseph H. Swartz. 1927. [Fungous diseases of the skin] a review of the literature [of the last two years], *Arch. Derm. Syphilol.* **15**: 404-414.

Greig, E. D. W. & G. C. Maitra. 1918. Observations on the occurrence of hyphomycetic elements in ulcers of the skin in 19 cases, *Indian Jour. Med. Res.* **5**: 481-490, *1 fig.*

Grohe. 1870. [Experimente . . . über die Injection von Pilzsporen], *Berlin. Klin. Woch.* **7**: 8, 9.

Grütz, O. 1927. Die Hyphenpilze oder Eumyceten, Hand. Path. Mikroorg. [Kolle & Wassermann, ed. 3] **5**: 133-320, *10 pls., 66 figs.*

Guéguen, Fernand. 1904. Les champignons parasites de l'homme et des animaux. Généralités, classification, biologie, technique. Clefs analytiques, synonymie, diagnoses, histoire parasitologique, bibliographie, Paris, xvii + 299 pp., *12 pls.*

Hallier, Ernst. 1866. Die Pflanzlichen Parasiten des menschlichen Körpers fur Aerzte, Botaniker, zugleich als Anleitung in das Studium der Niederen Organismen, Leipzig, 116 pp., *4 pls.*

—. 1869-1870. Die Parasiten der Infectionskrankheiten, Zeitschr. Parasitenk. **1**: 117-184, *Pls. 3, 4;* 290-352, 1869. **2**: 67-77; 113-132, 1870.

Hamman, Louis. 1927. The clinical manifestations of pneumonomycosis, *Am. Rev. Tuberculosis* **16**: 541-574.

Henrici, Arthur T. 1930. Moulds, yeasts and Actinomycetes. A handbook for students of bacteriology, New York, John Wiley & Sons, x + 296 pp.

Huber, Gerhard. 1933. Über die Pilzerkrankungen in der Mundhöhle, *Inaug. Diss. Med. Fak. Univ. Freiburg im Breisgau,* 25 p.

Jäger, G. F. 1816. Über die Entstehung von Schimmel im Innern des thierischen Körpers, *Deutsch. Arch. Physiol.* [Meckel's] **2**: 354-356.

Jeanselme, E. 1904. Cours de dermatologie exotique [recueilli et rédigé par Trémolières] Paris, 403 pp., *5 maps, 108 figs.* [Dermatomycoses exotiques pp. 234-285, Mycétome 286-304].

Keim, H. L. 1928. Impressions of dermatology in North China, *Arch. Derm. Syphilol.* **17**: 619-624.

Kesten, Beatrice M. 1929. Observations on skin diseases in Porto Rico, *Porto Rico Jour. Public Health Trop. Med.* **5**: 185-187.

Klestadt. 1922. Eine Pilzerkrankung eigener Art in der Rachenwand, *Zeitschr. Hals-, Nasen-Ohrenheilk.* **1**: 92-98, *2 figs.*

Küchenmeister, Friedrich. 1855. Die in und an dem Körper des lebenden Menschen vorkommenden Parasiten—2 vol. Leipzig. [II. Die pflanzlichen Parasiten, 148 pp., *5 pls.*]

Langeron, Maurice. 1930. Revue des travaux de mycologie pathologique exotique publiés au cours des années 1927-28, *Ann. Cryptog. Exot.* **3**: 13-42.

Leclercq, Jules. 1913. Les nouvelles mycoses chirurgicales des membres, *Arch. Gén. Chir.* **9**: 1430-1460.

LeDantec, A. 1924. Précis de pathologie exotique (maladies des pays chauds et des pays froids), ed. 4, Paris, Octave Doin, v. 1, 942 pp.; v. 2, 1232 pp.

*Löwenberg. 1880. Des champignons parasites de l'oreille humaine, Paris.

Magalhães, Octavio de & Aroeira Neves. 1926. Ensaios de mycologia. Contribuição para o estudo dos cogumelos em Bello Horizonte, Janeiro 1912–Junho 1920, *Mem. Inst. Oswaldo Cruz* 19: 245-283, *Pls. 56-91* [translated: Essays on mycology, contribution to the study of fungi in Bello Horizonte. Jan. 1912-June 1920, *Ibid.* 19: 285-322, 1926].

Maillard, J. P. 1933. Les mycoses du conduit auditif externe, *Thèse Fac. Méd. Univ. Paris* 537: 1-73.

Marchoux, E. 1922. Mycose pulmonaire, *Bull. Soc. Path. Exot.* 15: 919-920.

Mattlet, J. 1926. Mycoses dans l'Urundi, *Ann. Soc. Belge Méd. Trop.* 6: 1-41, *18 figs.*

Mayer, A. C. 1815. Verchimmelung (Mucedo) in lebenden Körper, *Deutsch. Arch. Physiol.* [Meckel's] 1: 310-312.

Mendelson, Ralph W. 1921. Tropical bronchopulmonary mycosis, *Jour. Am. Med. Assn.* 77: 110-112, *4 figs.*

—. 1925. Some interesting diseases observed in the clinic of the Bangkok Central Hospital, *Jour. Trop. Med. Hyg.* 28: 393-405, *31 figs.*

Mohler, J. 1904. Mycotic stomatites of cattle, *U. S. Dept. Agr. Bureau Animal Industry, Circ.* 51: 1-6.

Nannizzi, Arturo. 1934. Repertorio sistematico dei miceti dell'uomo e degli animali, Siena, S. A. Poligrafica Meini xii + 557 pp., *224 figs.* [Received in 1935 after this book was in galley proof, too late to be considered except for changes of nomenclature of species already included.]

Neumann, L. G. 1892. Traité des maladies parasitaires non microbiennes des animaux domestiques, ed. 2, Paris, XVI + 768 pp., *364 figs.*

Neveu-Lemaire, Maurice. 1911. Parasitologie des animaux domestiques. Maladies parasitaires non bactériennes, Paris, J. Lamarre & Cie, 1257 pp.

—. 1921. Précis de parasitologie humaine, ed. 5, Paris, J. Lamarre, VI + 466 pp.

Niethe, Ulrich. 1926. Die Bedeutung der gewöhnliche Schimmelpilze für die menschliche Haut, *Arch. Derm. Syphilis* 152: 358-364.

Ota, Masao. 1928. Champignons parasites de l'homme (Études morphologiques et systématiques), *Jap. Jour. Derm. Urol.* 28: [202 pp. in Japanese, 7 pp. of French summary, 5 pp. of bibliography].

Perazzi, Piero. 1926. I miceti dimoranti nella regione genitale della donna, *Atti R. Accad. Fisiocrit. Siena* 17: 361-410, *Pls. 1-2.*

Perin, Arrigo. 1925. Le micosi pulmonari e generalità sui miceti patogeni. Siena, Libreria Editrice Senese, viii + 294 pp.

Pinoy, E. 1903. Les champignons pathogènes; leur classification d'après les caractères botaniques, *Bull. Inst. Pasteur.* 1: 761-774.

Plaut, Hugo C. 1903, 1912. Die Hyphenpilze oder Eumyceten, *Handb. path. Mikroorganismen* [Kolle & Wassermann] 1: 526-660; ed. 2, 5: 1-154, *7 pls.*

Ramsbottom, John, & Arthur Whitfield. 1931. Fungi pathogenic to man, *Syst. Bact. in Relation to Medicine* [Med. Res. Council] 8: 11-70.

Raymond, Victor & Jacques Parisot. 1916. Étiologie, prophylaxie et thérapeutique de l'affection dite gelure des pieds, *C. R. Acad. Sci.* 162: 694-696.

Redaelli, P. 1931. Tecnica micologica medica, Bologna, L. Capelli. 227 pp., *58 figs.*

Robin, Charles. 1847. Les végétaux qui croissent sur les animaux vivants, *Thèse Fac. Sci. Paris,* VIII + 120 pp., *3 pls.*

—. 1853. Historie naturelle des végétaux parasites qui croissent sur l'homme et sur les animaux vivants, Paris, x + 704 pp. *Atlas 15 pls.*

Rockwell, George E. & John H. Highberger. 1927. The necessity of carbon dioxide for the growth of bacteria, yeasts, and moulds, *Jour. Inf. Dis.* 27: 438-446.

Rockwood, Ethel M. 1930. A study of fungus infected nails, *Arch. Derm. Syphilol.* 22: 395-400, *7 figs.*

Roeckl, G. 1884. Über Pneumonomykose. *Deutsch. Zeitschr. Thiermed. Vergleich. Path.* 10: 122-132, *Pl. 12.*

Rouyer, E. & J. Pellissier. 1915. Contribution à l'étude de certaines mycoses de blessures de guerre, *Ann. Inst. Pasteur* 29: 551-555.

Rudolph, Max. 1914. Über die brasilianische Figueira, *Arch. Schiffs-Tropenhyg.* 18: 498.

Sartory, A. 1920-1923. Champignons parasites de l'homme et des animaux, 14 pts. 1 suppl. 1-86, 1920; 91-484, 1921; 487-721, 1922; 727-895 and index 1-47, 1923; suppl. 1-78, 1923.

Schmidt, Hans. 1921. Über Beziehung zwischen Tuberkelbazillen und Schimmelpilzen, *Ztschr. Klin. Tuberkulose.* 46: 456-459.

Schmidt, P. W. 1933. Dermatomykosen, *Derm. Zeitschr.* 66: 241-261.

Sée, Pierre. 1922. Les mycoses, *Gaz. Hôp. Civ. Milit.* 95: 469-476.

Senator, H. 1891. [Pneumaturie und Diabetes], *Intern. Beitr. Wiss. Med.* 3: 319-332 [also cited Festschrift Rudolf Virchow].

Shear, Cornelius Lott. 1927. Mycology in relation to human pathology, *Am. Nat.* 61: 151-159.

Siebenmann, Friedrich. 1889. Die Schimmelmykosen des menschlichen Ohres. ed. 2, Wiesbaden, 118 pp., *4 pls.*

Sorokin, N. 1882. Rastytel'nye parazity cheloveka i zhivotnykh kak prichina zaraznykh boleznei dlia naturalistov, vrachei, studentov i veterinarov. 4 vol. and atlas. S. Peterburg.

Souls, Ferdinand Xavier Félix. 1891. Contribution à l'étude des otomycoses, *Thèse Fac. Méd. Pharm. Univ. Bordeaux* 9: 1-48, *2 figs.*

Stein, R. O. 1914. Die Fadenpilzerkrankungen der Menschen. München, 1914, 99 pp., *32 pls.* [also cited Lehmanns *Med. Atlanten.* 12: 1-99, *32 pls.*, 1914]; ed. 2, 128 pp., *32 pls.*, 1930.

Strong, Richard P. 1930. The African republic of Liberia and the Belgian Congo. Based on observations made and material collected during the Harvard African expedition, 1926-1927. Cambridge [Mass.], Harvard University Press, v. 1, xxvi + 568 pp., *6 pls.*

Strong, Richard P. & George C. Shattuck. 1930. Medical and pathological investigations in Liberia and the Belgian Congo, *Contr. Dept. Trop. Med., Inst. Trop. Biol. & Med.* 55: 210-461.

Talice, Rodolfo V. 1930. Le concept actuel des mycoses médicales de l'appareil respiratoire, *Rev. Sud-Amer. Méd. Chir.* 1: 181-188.

Thibierge, G. 1925. Les enseignements dermatologiques de la guerre 1914-1918, *Ann. Derm. Syphiligr.* 6: 481-514; 641-661; 705-724. [III. Mycoses cutanées, pp. 641-653.]

Uhthoff, W. 1883. Beiträge zur pathologischen Anatomie des Auges. III. Partielle Necrose der menschlichen Hornhaut durch Einwanderung von Schimmelpilzen, *Arch. Ophthalmol.* 29: 3: 178-181.

Virchow, Rudolf. 1856. Beiträge zur Lehre von den beim Menschen Vorkommenden pflanzlichen Parasiten, *Arch. Path. Anat. Physiol.* [Virchow's] 9: 557-593.

Vuillemin, Paul. 1931. Les champignons parasites et les mycoses de l'homme. Paris, Paul Lechevalier & Fils, 291 pp.

Weidman, Fred D. 1929. Light from the botanic field on medical mycologic problems, *Arch. Derm. Syphilol.* 19: 867-877.

Wright, James Homer. 1913. Non-bacterial fungus infections—the mycoses, in Osler, William & Thomas McCrae, Modern medicine in theory and practice—ed. 2, 1: 1033-1060.

Xavier, A. A. 1926. Apontamentos sobre micologia (Notas de um curso), *Sciencia Med.* (Rio de Janeiro) 4: 60-68.

Young, James. 1921. Organism cultivated from carcinomata, *Brit. Med. Jour.* 1: 933.

Zürn, Friedrich Anton & Hugo C. Plaut. 1887-1889. II. Die pflanzliche Parasiten in Zürn, F. A., Die Schmarotzer auf und in dem Körper unserer Haussäugetiere sowie die durch erstere veranlassten Krankheiten, deren Behandlung und Verhütung. Weimar, 837 pp., *4 pls.*

CHAPTER II

PHYSIOLOGY OF FUNGI WITH SPECIAL REFERENCE TO REPRODUCTION

The life of a fungus may be divided into three periods: (1) vegetative growth, (2) multiplication by asexual means, and (3) the development of sexual organs usually resulting in a spore able to resist unfavorable factors of the environment. Since studies of classification and evolution of the various groups of fungi are usually based on this last stage which presents the greatest diversity of phenomena, much of laboratory work in the last half century has been directed toward securing the production of sexual stages. After Bary, Brefeld, Hansen and Zopf had developed the technic of cultivation, Klebs in the years from 1896 to 1904 laid the foundations of much of our present knowledge by detailed studies of the conditions necessary for vegetative growth and reproduction in a few organisms. Subsequent work of C. H. Kauffman and his students has done much to extend Klebs' generalizations to further groups of fungi and to confirm his well-known dicta. These may be summarized as follows:

1. Among all organisms, growth and reproduction are life processes, which depend upon different conditions: among lower organisms, probably environment determines whether growth or reproduction will occur.
2. As long as the environment is favorable for growth, reproduction will not occur. An environment favoring the latter is usually more or less unfavorable to further growth.
3. The limits of each factor of the environment are narrower for reproduction than for growth. Therefore growth can still take place, although reproduction is limited by a too weak or too strong influence of some factor.
4. Before reproduction can occur growth must have been sufficient to have stored the products necessary for the reproductive processes.

As a consequence of these dicta, most specialized methods for securing sexual or even asexual reproduction in a given group consist essentially in growing the organism for a time as nearly at optimum conditions as possible, then suddenly changing one or more factors of the environment to a condition less favorable for growth but still within the limit for reproduction. Examples of this will be given in the following analysis of some of the chief factors of the environment.

Water.—The water requirement and transpiration have been little studied in fungi. While spores often have mechanisms for resisting desiccation over long periods and some very complex specialized structures are developed among the higher fungi for preventing the reproductive organs from drying out, in general the fungi both grow and reproduce in relatively high humidities. The optimum humidity seems very closely related to oxygen supply and respiration. Many of the lower fungi grow well, or even normally are found, immersed in water. Many others will form a thick hyphal mat over the surface of a liquid culture medium, although in this case much more oxygen is required for normal development than in purely aquatic fungi and the reproductive structures are usually produced in the aerial mycelium. Still other groups will grow well and reproduce only on solid substrata, and a few grow best in comparatively low humidities. Growth is usually much slower at low humidities.* Some species have a narrow range while others will tolerate a very wide range.

Transpiration rates and humidity are often important in initiating reproduction. Very frequently reproductive structures are produced only when vegetative growth is severely checked by the drying out of the media. This, however, is usually associated with partial exhaustion of nutrients and the accumulation of toxic products of metabolism (staling) so that it is often difficult to evaluate the influence of the various factors. (Klebs 1896, Coons 1916.)

Nutrition.—The most emphasis has been placed upon this factor and a great body of literature on culture media and their effects has been produced. The complexity of the vast majority in use does not lend itself to an analysis of the separate factors involved. These may be considered under the headings of inorganic salt requirements, carbon and nitrogen supply, and relations to concentration of hydrogen ions, although these are closely interdependent and also related to the physical factors of the environment.

Inorganic Salts.—The requirement of these seems much the same as for the higher plants, traces of potassium, magnesium, iron, and calcium being necessary to secure good growth and reproduction. Calcium, however, is much less important for fungi than for the flowering plants. Of the nonmetallic elements, phosphorus, sulphur, carbon, and nitrogen are important. Other elements are often present and may influence growth and reproduction, but they are relatively unimportant in comparison with the above (e.g., McHargue & Calfee 1931). Phosphorus is usually supplied as a phosphate, where it is often useful in regulating the concentration of hydrogen ions in the solution. In many media it is supplied as nucleoproteins, nucleic acid, and lecithin, and seems equally available in these forms.

Sulphur.—This element is usually supplied as a sulphate, but is also utilized from sulphocyanates, thiosulphates and the sulphur-containing amino acids and their compounds. The literature on this subject was well summarized by Armstrong (1921) and will not be covered here. In various organic media probably a large portion of the necessary sulphur is available from the proteins since practically all of them contain some cystine or cysteine. Where large amounts of sulphur are available, particles of sulphur may be deposited in the cells or hydrogen sulphide may be produced, although these phenomena are rare under ordinary cultural conditions.

---

*This fact may be utilized in stock cultures by transferring to a 4-5% agar instead of 1½-3% commonly employed. Since growth is slow and water loss is slower from the harder agar, one safely can allow a much longer time to elapse between transfers.

Carbon.—The possible sources of carbon are almost infinite, since there are many possible combinations from which it may be utilized in dilute solution. For practical purposes the carbohydrates and organic acids are employed most. Of these, glucose has the widest use although the other hexoses, especially mannose and fructose, are easily utilized, and also sucrose (cane sugar) by organisms which secrete invertase. The other sugars and aldehydes, celluloses, starches, etc., are variable in effect, those with low molecular weights generally being toxic. The lower alcohols are also generally toxic, although some of higher molecular weight, such as glycerol (glycerin) and mannitol (mannite), are very readily assimilated. In general, substances having a three- or six-membered carbon chain are the most assimilable. Among the organic acids, the amino acids and those of the aliphatic series having a low hydrogen ion concentration, are readily utilized. Acids of the cyclic (benzene) and heterocyclic series are rarely metabolized unless there is a side chain of at least three carbon atoms, as in the amino acids, phenylalanine, tyrosine, and tryptophane. There are also scattered observations on utilization of depsides, tannins, alkaloids, amines, etc. The proteins and their decomposition products often furnish a suitable carbon source, although they are primarily regarded as a nitrogen source.

In many of the compounds assimilability depends upon the ability of the organism in question to secrete some enzyme which will hydrolyze or so break down the higher compound that one or more of the resulting products will be utilizable while none will be toxic, e.g., in depsides and tannins, usually the hexose is utilized and the galloyl compounds are not attacked.

Many of the older authors attempted to arrange carbon compounds in the order of decreasing availability, but this is rather futile, as the exact order varies with the organism in question and with other environmental factors. (Pasteur 1860, 1862; Naegeli 1879, 1882; Reinke 1882; Duclaux 1885, 1889; Linossier & Roux 1890; Went 1901; Ekman 1911. For action of cyclic carbon compounds, see Waterman 1913, Bokorny 1920.)

Nitrogen.—While from time to time atmospheric nitrogen has been indicated as a source of nitrogen for fungi, the inadequacy of methods of determination of total nitrogen has tended to discredit this source for most fungi. Duggar and Davis (1916) have carefully summarized the literature and discussed the methods employed. Klotz (1923) has adequately summarized the literature for other sources. Older authors attempted to group fungi as nitrate, ammonium, amino acid, peptone or protein organisms, but in view of the large number of variables involved and the difficulties of adopting a suitable criterion for growth these groupings are quite inadequate. While some fungi are capable of utilizing nitrates or ammonium salts, in the groups in which we are most interested here, they are so few that they need not be considered. Czapek (1902) made a very extensive study of substances as nitrogen sources and concluded that amino acids and compounds nearly resembling them, are most fully and easily utilized, since the principal use of nitrogen in nutrition is in the production of proteins. Lutz (1905) extended and confirmed these observations. Ritter (1909, 1912, 1914) studied the effect of the acid produced when ammonium salts were used. Kossowicz (1912, 1914) extended his studies to purines and related compounds. Brenner (1911) extended his observations to include many compounds which proved toxic.

While these and many other later papers have much interest for the problem of the mechanism of protein synthesis in fungi, they have little direct bearing on the problems of cultivation.

Few studies have been made on the vitamin requirements of fungi, and the evidence is not very conclusive at present. (See excellent review of literature by Sergent 1928, Peskett 1933.) However, the possibility of such factors should be borne in mind in nutritional studies (see Freedman & Funk 1922; Robertson & Davis 1923).

The problem of nutrition of fungi is closely bound up with the varying degrees of parasitism. The division of fungi into saprophytes and parasites is rather artificial since there are so many intergrading forms. However, it is often convenient to speak of facultative parasites, species which normally are saprophytic, but under especially favorable conditions may develop in the tissues of other organisms, usually as secondary invaders. Other fungi may develop during part of their life cycle as parasites and reproduce sexually only on the dead tissues of the host, or, vice versa, with a reproductive cycle in the living host and saprophytic vegetative existence outside, as in *Coccidioides immitis.* A few, such as the plant rusts and the Laboulbeniales on living insects, complete their whole life cycle on the living host, and have not been successfully cultivated apart from their hosts.

Even more artificial and confusing are the terms employed for symbiosis and related phenomena to express varying degrees of the interaction of two organisms which may vary all the way from parasitism at one extreme to epiphytism at the other.

Hydrogen Ion Concentration.—Although biologists have ceased attempting to explain nearly all phenomena by hydrogen ion concentrations, yet these do play an important part in metabolism and should be considered. At this point it might be well to review briefly the underlying concepts and the methods of determining this concentration of hydrogen ions.

In a given ionizing solvent, of which water is the only one which can concern us here, solutions of various substances are observed to conduct an electric current to a greater or lesser degree. Pure, distilled water is for all practical purposes a nonconductor. Solutions of sugar for instance, are quite as unaffected by electric current as pure water. Acetic acid in solution conducts a given current slightly, while substances such as HCl, NaCl, and NaOH are strong conductors when dissolved.

It is quite reasonable, then, to assume that in conducting solutions there are present conducting units and that the quantity of current conducted is in some way proportional to the numbers of these units. Now, since most of these substances that are good conductors when dissolved are nonconductors in the absence of moisture, we must postulate some change in the solute. Without going any further into the proofs for electrolytic dissociation, we will state here very simply the long accepted fact that if a substance when dissolved in water is found to be a conductor of electric current, it dissociates from the uncharged form into ions capable of carrying current and yet balancing one another in electric charges. The graphic representation of this fact may be made as follows: $XY \rightleftharpoons X^+ + Y^-$. Arrows are used to indicate that this is an equilibrium, not a completed reaction, that must adjust itself to whatever other equilibria other solutes may necessitate.

Let us take, now, the hypothetical acid HA. It dissolves in water and dissociates according to the following representation:

$$HA \rightleftharpoons H^+ + A^-$$

At the instant of solution we may visualize the undissociated acid breaking up into H^+ and A^- ions and the dissociated ions recombining to form HA at such rates that the equilibrium for the given acid will be established. Thereafter the rates of dissociation and reassociation must be equal. If, now, we add to the solution, some salt BA, then the concentration of the A^- ions will be materially increased. If by any chance we have doubled the concentration of A^- we have doubled the possibility of collisions between H^+ and A^- and doubled the velocity of the reaction from right to left. If now, we add another acid so that the concentration of H^+ will be doubled, we have, obviously, quadrupled the possibility of collision. The velocity, then, in a given direction is proportional to the products of the concentrations of the reacting groups. Representing concentrations by square brackets, we may express this as follows:

Velocity from right to left $k_1\ [H^+]\ [A^-]$ where k_1 is the proportionality factor.

At the same time, however, we are having HA redissociating at a rate proportional, more or less, to the concentration.

Velocity from left to right $k_2\ [HA]$. Since, as we have already stated, equilibrium is established, the velocity in one direction must be equal to the velocity in the other. Equating these two expressions, we get:

$$k_1\ [H^+]\ [A^-] = k_2\ [HA]$$

or

$$\frac{[H^+]\ [A^-]}{[HA]} = \frac{k_2}{k_1} = K_A$$

which will be a determinable quantity, characteristic of the solute for which it is determined and referred to as equilibrium or ionizing or dissociation constant.

Similarly, a hypothetical base BOH, dissociating as follows:

$$BOH \rightleftharpoons B^+ + OH^-$$

will have a characteristic ionization constant expressed by the equation:

$$K_B = \frac{[B^+]\ [OH^-]}{[BOH]}$$

And the salt BA:

$$BA \rightleftharpoons B^+A^-$$

$$K_{BA} = \frac{[B^+]\ [A^-]}{[BA]}$$

Assume, now, that we mix equal quantities of two solutions, one of the acid and one of the base, in equivalent concentrations. We will have then in solution the four ions: H^+, A^-, B^+, OH^-. These will adjust themselves so that the constants, K_A, K_B, K_{BA}, will be satisfied and, in addition, another constant which will express the equilibrium between the H^+ and OH^- ions as follows:

$$K_{HOH} = \frac{[H^+]\ [OH^-]}{[HOH]}$$

Since HOH is water and since the quantity formed in a given solution by reassociation of ions is negligible in comparison with the sum total of molecules present, we may for all useful purposes write the equation:

$$K_W = [H^+]\ [OH^-]$$

The above is a relationship that holds in all aqueous solutions. However concentrated the hydrogen ions, there still must always be enough hydroxyl ions present to satisfy the constant; however concentrated the hydroxyl, there must still be enough hydrogen ions. Thus, for instance, we might express the acidity of solutions in terms of the hydroxyl ion concentration. As a matter of convention, but not necessity, we express acidity and alkalinity in terms of hydrogen ion concentration.

K_W has been determined with considerable care to be practically $\frac{1}{10^{14}}$ or 10^{-14}. Thus $[H^+]\ [OH^-] = 10^{-14}$ always holds, whatever the solute or solutes. In chemically pure, distilled water, which is of course entirely neutral, $[H^+] = [OH^-] = 10^{-7}$. A neutral solution, then, is one in which this equation holds. For higher concentrations of hydrogen ions, those from $[H^+] = 10^1$ up to $[H^+] = 10^{-7}$ (remember the exponent is negative) solutions give acid reactions. For lower concentrations, between $[H^+] = 10^{-7}$ and $[H^+] = 10^{-14}$, solutions are alkaline.

As a convenience in manipulation, the reciprocal of the hydrogen ion concentration is generally used. This obviates the use of the negative exponent. Thus, in alkaline solutions, $\frac{1}{[H^+]}$ varies between 10^7 and 10^{14}, another way of expressing the facts expressed above, but somewhat simpler. It is still simpler, and quite permissible, to use the logarithm of the reciprocal $\frac{1}{[H^+]} = 10^x$ $\log_{10} \frac{1}{H^+} = x \log_{10} 10$. Since the logarithm of ten is unity, $\log \frac{1}{H^+} = x$. This x, the logarithm of the reciprocal of the hydrogen ion concentration, is what is referred to as the pH of a solution. It follows, then, that from pH 1 to pH 7 a solution is acid and from 7 to 14, a solution is alkaline.

There are two common methods of measuring hydrogen ion concentration. The most direct method is by measuring the potential of the so-called hydrogen electrode in a portion of the solution to be determined. It has been found that with this quantity measured, the concentration may be deduced very simply according to the following formula:

$$\frac{\text{Potential}}{\text{Numerical factor}} = \log \frac{1}{[H^+]}$$

With the factor once determined and the potential directly measured, there should be no further difficulty. The apparatus, however, is expensive and while apparently simple to manipulate is actually unreliable except in the hands of an expert who appreciates the various possible sources of error and is ever on the alert for them. There are many types of potentiometer on the market, but it is safe to say that none of them is fool-proof.

The indirect method, the colorimetric, depends upon the fact that certain series of organic compounds exhibit great changes in color with varying pH. Phenolphthalein, for instance, is colorless in acid solution, but becomes magenta at pH 9. Litmus is violet in alkaline solutions, red in acid, changing at approximately pH 7. Suitable indicators may be found for almost any desired pH or range of pH's, notable among which are a long series of sulphonphthaleins and another of azo compounds.

There is not space here to go into the theory of indicators or even to list them. Thorough and satisfactory discussions may be found elsewhere. While apparently crude, this method, in addition to the obvious advantages of being cheap and quick, may, in the hands of a normal, intelligent manipulator, be developed to quite a high degree of accuracy.

It must be remembered that the color perception of some individuals is very imperfect so that no amount of training will give them satisfactory results with a colorimetric method in biochemistry or bacteriology. The extremely simple method of matching colors with a colored chart, such as furnished by Clark (1920, 1922), is only a very rough approximation and is practically useless with even slightly clouded solutions. A more reliable method, in which the unknown + indicator is compared with a standard + indicator as seen through an equal depth of solution without indicator, is quite commonly used and is satisfactory if the unknown solution is not highly colored. It is important that the vessel be of the same size, shape, material, color, and thickness, and that the light intensity be equal. Simple devices may be purchased quite cheaply. By carefully eliminating sources of error by use of a colorimeter of the Duboscq type and varying the light intensity, the writer (Dodge 1919, Duggar & Dodge 1919, Duggar 1919) was able to secure as great accuracy as is usually attained by the potentiometric method, and extend the range of indicators in both directions so that only half as many need be used as in the usual series proposed by Clark & Lubs (1917). It should also be kept in mind that the alkali slowly dissolves from glass, increasing the alkalinity of solutions so that standards sealed in glass should not be used indefinitely. The safest way is to prepare carefully one's own standards and store them in paraffin lined bottles, for use as occasion demands.

These standards, usually mixtures of buffers, are solutions of weak acids and their salts, which can maintain their pH almost unaltered on the addition of considerable quantities of strong acids or bases. Any substance capable of removing hydrogen or hydroxyl ions from the solution either physically or chemically will act as a buffer; e.g., Bovie (1915) has shown that charcoal has a buffer action. We have, however, to deal only with chemical buffers, a simple explanation of which might not be amiss.

Acetic acid (we will indicate the acetate group, CH_3COO^-, here by the simplified Ac^-) is a weak acid. That is, though in a normal solution there is one gram atom of ionizable hydrogen per liter, most of this remains as un-ionized HAc and the reaction of the solution is only slightly acid, the pH being only a little below 7. Sodium acetate, being a salt, is almost completely ionized.

$$NaAc \rightleftharpoons Na^+ + Ac^-$$

The Ac^- ion will immediately start to take up the H^+ ion of the water until the dissociation constant for HAc is satisfied. This will liberate an excess of OH^- ions which will remain virtually uncombined because NaOH is a very highly ionized base. Thus a normal solution of pure NaAc in pure water will give a definitely alkaline reaction.

Assume now that we have in a given solution a mixture of solutions of HAc and NaAc in such proportions that the resulting reaction of the mixture is acid. We have, then, present large quantities of Na^+, OH^-, H^+ and Ac^- ions and of un-ionized HAc, practically no un-ionized NaOH. Let us now visualize what would happen if to such a solution we add a solution of a strong acid, such as HCl, almost completely ionized to H^+ and Cl^-. The reaction does not, as one might hastily assume, turn sharply acid. Before the pH can be materially lowered, the free H^+ added must first adjust its equilibrium with the free Ac^- and OH^- in the solution. This will be accomplished by association into almost un-ionized HAc and HOH and until this is accomplished, addition of HCl will not materially affect the reaction of the solution.

By suitably selecting the acid and its salt, we may secure satisfactory buffers for almost any region of the whole pH scale. Boric acid, H_3BO_3, and phosphoric acid, H_3PO_4, are among those most commonly used. These have the double advantage of being weak acids and of ionizing in three stages: e.g.

$$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$$
$$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^=$$
$$HPO_4^= \rightleftharpoons H^+ + PO_4^{\equiv}$$

The dissociation constants of these three stages are successively smaller, the possible use in buffering correspondingly greater.

The actual composition of the buffer solutions we will not go into here, save to state briefly that boric acid is usually used in conjunction with borax, while, instead of using phosphoric acid itself, there is used a mixture of the two salts KH_2PO_4 and Na_2HPO_4 (or, rather, its hydrate). Clark (1922) gives a series of possible buffers, with directions for their preparation and tables showing their pH range.

For a comprehensive discussion of the subject one should consult such works as those of Clark (1922) and Michaelis (1926).

This matter of buffers is very important in the preparation of media and in interpreting the results of older authors, who measured the total acidity, usually using phenolphthalein as an indicator. It was customary to titrate a sample medium and add the calculated amount of acid or alkali necessary for a given total acidity. If the medium was made up of phosphates, etc., as some of the early media were, this added acid had little real effect, while if few buffers were present it might change the reaction very much.

While generalizations are unwarranted, a large number of observations indicate that most bacteria grow best betwen pH 7 and 9 while most fungi grow best between pH 5 and 7 with some, especially members of the Aspergillaceae, able to grow slowly at much higher acidities. This fact is sometimes utilized in restraining the growth of bacteria in isolations by using media to which a small quantity of an organic acid, such as acetic or lactic acid, has been added (see p. 59). Klebs' dicta hold in this case as well as in other factors of the environment, since growth is possible at a much wider range than is reproduction. Talice (1930) records optima, maxima, and minima of about thirty common human pathogens on three usual media. (See also notes of Mallinckrodt-Haupt 1929, 1932; Kadisch 1929.)

Oxygen Requirements.—Since the fundamental processes of respiration are the same for plants and animals and are already known as to conditions and end products, no attempt will be made to discuss aerobic and anaerobic respiration here. Such works as that of Kostychev and Lyon (1927) and current textbooks on general physiology may be consulted for further information. However, one should clearly distinguish between oxidation and fermentation phenomena. Space will not permit of a full discussion of this problem here, but some practical suggestions will be given in connection with the methods for the study of fermentation (see p. 62). In general, little attention need be given to a consideration of oxygen supply under the ordinary conditions of culture (Kadisch 1933). It sometimes happens, however, that in small, tightly plugged test tubes there may not be a sufficient amount of oxygen present to support sexual reproduction. In some cases a sudden change in oxygen pressure may stimulate reproduction, especially if applied along with other changes in the environment.

Temperature Requirements.—These vary greatly with the species, some of which grow well only at body temperature while others will make good growth at all temperatures between room temperature (20° C.) and body temperature (37.5° C.). The earlier authors spent much time in search for an optimum temperature, little realizing that a temperature may be optimum for an organism under one set of conditions while far from optimum under another set of conditions (Blackman 1906). Later studies considered the effect of temperature on rate of growth and found that growth roughly follows van 't Hoff's law of doubling the rate for every ten degrees of temperature in the middle part of the temperature range, but with a rapid falling off of rate after a certain critical point is reached. The limits of growth are usually much wider than those of reproduction as Klebs postulated. In general, spores are adapted to withstand higher and lower temperatures than vegetative structures, and ordinarily, thick-walled spores are much more resistant than thin-walled spores, while spores resulting from the sexual act are more resistant than those of asexual origin.

Influence of Light.—That light has strong morphogenic influence has long been recognized from observations in nature (well summarized by Elfving 1890). Since some organisms develop reproductive organs only in response to light stimuli, light may be of considerable importance in cultures. On the other hand, many fungi seem to develop as well in the dark as in the light. Elfving suggested that light acts as an inhibitor of organic synthesis and that the closer the food available is to the constituents of the protoplasm, the less action the light has. In most plants light, especially of shorter wave lengths, tends to restrict vegetative growth. Many subsequent investigators have extended these early observations. Neidhart (1924) reports lethal action of x-rays and radium in *Sporotrichum* and *Ectotrichophyton gypseum*. Nadson & Phillippov (1925) report interesting effects of x-rays on sexuality in Mucoraceae. Dorne & White (1931) report differential action of x-rays in different groups of fungi, while using the x-rays for therapeutic purposes. (See also Liebesny, Wertheim & Scholz 1933.)

Chemotropism.—The strongest chemotropic reaction of hyphae is usually negative; the hyphae grow away from regions which have been staled by the products of their own metabolism (Clark 1902, Fulton 1906, Balls 1908, Graves 1916, Brown 1922, 1923, 1925, Pratt 1924). A simple example of this reaction is found in the circular growth of mycelia. In so far as a clear field is available, the hyphae tend to grow equally in all directions from the point of infection. The same factor may account for the alternate dense and sparse zones which characterize many fungal colonies.

Energetic growth results in the deposition of catabolic substances, and growth is accordingly reduced until a few hyphae pass beyond the inhibiting zone and give rise to a new ring, or frequently the germination of fresh spores outside this zone produces a similar effect. Ammonia and potassium bicarbonate are often among the substances producing staling, as this phenomenon is called. Incubation at higher temperatures hastens staling.

Hydrotropism may occur but is difficult to prove.

Phototropism.—Many reproductive structures are very sensitive to light and by means of this reaction adjust themselves in a position favorable to the distribution of their spores, since the direction of light is usually that of the direction of open spaces (Buller 1909-1931, Jolivette 1914, Parr 1918, and Blaauw 1914). It is probable, however, that there is little positive phototropism among the human pathogens.

Radium.—Little work has been done on the effect of radium on pathogenic fungi. Sartory & Meyer (1926) report that in *Aspergillus fumigatus* on media containing salt, exposure to 3-7.2 millicuries, either discontinuous or continuous, produced an increase of conidiophores, with a tendency to decrease the size of the head and approach conditions found in *Penicillium*. On media nearly free from salts, there was a tendency to form large-celled oidia rich in oils, or large, thick-walled spores, 3-8μ in diameter, singly or in pairs, and large pseudosporangia, 30μ in diameter, with echinulate walls but no spores observed within them. It was noted at the same time that in dissociated media reducing power was lowered and pH was increased. (Sucrose 5 gm., gelatin 7.5 gm., NaCl 1 gm., carrot juice q. s. for 100 c.c.) In undissociated media, reducing power was increased and pH was decreased.

With higher dosage (10.2 millicuries per sq. cm.), hard, fusiform sclerotia were produced in submersed mycelium. These contained perithecia.

BIBLIOGRAPHY

Armstrong, G. M. 1921. Sulphur nutrition; the use of thiosulfate as influenced by hydrogen ion concentration, *Ann. Missouri Bot. Gard.* 8: 237-281.

Balls, W. Lawrence. 1908. Temperature and growth, *Ann. Bot.* 22: 557-591, *11 figs.*

Blaauw, A. H. 1914. Licht und Wachstum I, *Zeitschr. Bot.* 6: 641-703.

Blackman, F. F. 1906. Optima and limiting factors, *Ann. Bot.* 19: 281-295, *2 figs.*

Bokorny, Th. 1917. Benzolverbindungen als Nährsubstanzen, *Zentralbl. Physiol.* 32: 55-63.

Bovie, William T. 1915. A direct reading potentiometer for measuring and recording both the actual and the total reactions of solutions, *Jour. Med. Res.* 33: 295-322, *14 figs.*

Brenner, W. 1911. Untersuchungen über die Stickstoffernährung des Aspergillus niger und deren Verwertung, *Ber. Deutsch. Bot. Ges.* 29: 479-483.

Brown, William. 1922. On the germination and growth of fungi at various temperatures and concentrations of oxygen and carbon dioxide, *Ann. Bot.* 36: 257-283, *4 figs.*

—. 1923. Experiments on the growth of fungi in culture media, *Ann. Bot.* 37: 105-129, *7 figs.*

—. 1925. Studies in the genus Fusarium. II. An analysis of factors which determine certain microscopic features of Fusarium strains, *Ann. Bot.* 39: 373-408.

Buller, Arthur Henry Reginald. 1909-1934. Researches on Fungi. vols. 1-6. Longmans Green & Co. London.

Cerutti, Pietro. 1933. Concentrazione idrogenionica e sviluppo degli ifomiceti patogeni: ricerche sperimentale e cliniche, *Pathologica* 25: 32-37.

Clark, Judson F. 1902. On the toxic properties of some copper compounds with special reference to Bordeaux mixture, *Bot. Gaz.* 33: 26-48, *7 figs.*

Clark, William Mansfield. 1920, 1922. The determination of hydrogen ions, Baltimore, Williams & Wilkins Co., 317 pp., 1920; ed. 2, 480 pp., 1922.

Clark, William Mansfield & H. A. Lubs. 1917. The colorimetric determination of hydrogen ions and its applications in bacteriology, *J. Bact.* 2: 1-109.

Coons, George H. 1916. Factors involved in the growth and the pycnidium formation of Plenodomus fuscomaculans, *Jour. Agr. Res.* 5: 713-769.

Czapek, Karl. 1902, 1903. Untersuchungen über die Stickstoffgewinnung und Eiweissbildung der Schimmelpilze, *Beitr. Chem. Physiol. u. Path.* 1: 538-560, 1902; 3: 47-66, 1903.

Dodge, Carroll William. 1919. [The fate of] Tyrosine in fungi: chemistry & methods of studying the tyrosinase reaction, *Ann. Missouri Bot. Gard.* 6: 71-92.

Dorne, Maurice & Cleveland White. 1931. Treatment of superficial infections with the long wave length Roentgen rays (Grenz rays), *Arch. Derm. Syphilol.* 24: 409-416.

Duclaux, E. 1885. Sur la valeur alimentaire de diverses substances pour l'Aspergillus niger, *C. R. Soc. Biol.* 37: 91-94.

—. 1889. Sur la nutrition intracellulaire, *Ann. Inst. Pasteur.* 3: 97-112, 413-428.

Duggar, Benjamin Minge. 1919. The microcolorimeter in the indicator method of hydrogen ion determination, *Ann. Missouri Bot. Gard.* 6: 179-181.

Duggar, Benjamin Minge & A. R. Davis. 1916. Nitrogen fixation, *Ann. Missouri Bot. Gard.* 3: 413-437.

Duggar, Benjamin Minge & Carroll William Dodge. 1919. The use of the colorimeter in the indicator method of hydrogen ion determination, *Ann. Missouri Bot. Gard.* 6: 61-71.

Ekman, Gunnar. 1911. Studien über den Nährwert einiger Kohlenstoffquellen für Aspergillus niger van Tiegh, *Öfversight af Finska Vetensk Soc. Förh.* 53A: 16: 1-43.

Freedman, Louis & Casimir Funk: Nutritional factors in the growth of yeasts and bacteria, I. Vitamines, *J. Metab. Res.* 1: 457-468. II. Protein hydrolysates, *Ibid.* 1: 469-480.

Fulton, Harry R. 1906. Chemotropism of fungi, *Bot. Gaz.* 41: 81-108.

Graves, Arthur Harmount. 1916. Chemotropism in Rhizopus nigricans, *Bot. Gaz.* 62: 337-369, *4 figs.*

Janke, Alexander & Stephan Kropacsy. 1929. Die Bestimmung des Wasserexponenten mittels des Stufenphotometers. I, *Biochem. Zeitschr.* 213: 154-169.

Jolivette, Hally D. M. 1914. Studies in the reactions of Pilobolus to light stimuli, *Bot. Gaz.* 57: 89-121, *12 figs.*

Kadisch, E. 1929. Über die Bedeutung der Nährbodenalkalität in der Mykologie, *Derm. Zeitschr.* 55: 385-396.

—. 1933. Der Einfluss von Temperatur und Sauerstoff auf die Lokalisation der Infektionen. Wägende Untersuchungen an Fadenpilzen. Untersuchungen mit dem Pulfrich Photometer an Hefen. Modifikation des Pulfrich Photometers, *Arch. Derm. Syphilis* 168: 438-475, *10 figs.*

Klebs, Georg. 1896. Die Bedingungen der Fortpflanzung bei einigen Algen und Pilzen, Jena, G. Fischer, 543 pp., *3pls.*

Klotz, L. J. 1923. Some aspects of nitrogen metabolism in fungi, *Ann. Missouri Bot. Gard.* 10: 299-368.

Kossowicz, A. 1912. Die Zersetsung von Harnstoff, Harnsäure Hippursaure und Glykokoll durch Schimmelpilze, *Zeitsch. f. Garungs-Physiol.* 1: 60-62; 2: 51-54. Nitritassimilation, *Ibid.* 2: 55-58. Über das Verhalten einiger Schimmelpilze zu Kalkstickstoff, *Ibid.* 2: 124, 125, 1912.

—. 1914. Zur Kenntnis der assimilation von Kohlenstoff- und Stickstoff-verbindungen durch Schimmelpilze, *Bioch. Zeitschr.* 67: 391-399. Über das Verhalten von Hefen und Schimmelpilze zu Nitraten, *Ibid.* 67: 400-420.

Kostychev, S. & C. J. Lyon. 1927. Plant respiration, Philadelphia, P. Blakiston's Son & Co., 163 pp.

Liebesny, P., H. Wertheim & H. Scholz. 1933. Über Beeinflussung des Wachstums von Mikroorganismen durch Kurzwellenbestrahlung I, *Klin. Woch.* 12: 141-145.

Lutz, L. 1905. Sur l'assimilabilité comparée des sels ammoniacaux, des amines, des amides et des nitriles, *C. R. Acad. Sci. Paris* 140: 665-667.

McHargue, J. S. & R. K. Calfee. 1931. Effect of manganese, copper, and zinc on growth and metabolism of Aspergillus flavus and Rhizopus nigricans, *Bot. Gaz.* 91: 182-193.

Mallinckrodt-Haupt, Asta St. von. 1929. pH Messungen bei Pilzkulturen, *Derm. Zeitschr.* 55: 374-384.

—. 1932. Der Wert der pH Messung bei Pilzkulturen, *Zentralbl. Bakt.* I. 125: 368-374.

Meyer, Jacques. 1927. Contribution à l'étude de l'Aspergillus fumigatus Fresenius. Étude expérimentale de l'influence du radium et des milieux sur la production de phénomènes sexués, *Thèse Fac. Pharm. Univ. Strasbourg* 31: 1-112, *30 figs.*

Michaelis, L. 1926. Hydrogen ion concentration, its significance in the biological sciences and methods for its determinations. I. Principles of the theory. Authorized translation by William A. Perlzweig, Baltimore, Maryland. Williams & Wilkins Company.

Nadson, G. A. & G. S. Philippov. 1925. Influence des rayons X sur la sexualité et la formation des mutantes chez les champignons inférieurs (Mucorinées), *C. R. Soc. Biol.* 93: 473-475.

Naegeli, Carl. 1880. Ernährung der niederen Pilze, *Bot. Mitt.* 3: 395-483. *K. Akad. Wiss. München, Math. Nat. Cl., Sitzungsber.* 10: 277-367.

—. 1882. Ernährung der niederen Pilze durch Kohlenstoff- und Stickstoffverbindungen. *Untersuchungen über niederen Pilze aus dem Pflanzenphysiologischen Institut in München.* 1-75.

Neidhart, Leo. 1924. Beitrag zur Strahlenempfindlichkeit pathogener Hautpilze (Sporotrichum Beurmanni und Trichophyton gypseum), *Inaug. Diss. Med. Fak. Univ. Zürich,* 29 pp.

Parr, Rosalie. 1918. The response of Pilobolus to light, *Ann. Bot.* 32: 177-205.

Pasteur, Louis. 1860. Mémoire sur la fermentation alcoolique, *Ann. Chim. et Phys.* III 58: 323-426.

—. 1862. Mémoire sur les corpuscules organisés qui existent dans l'atmosphère, examen de la doctrine des générations spontanées, *Ann. Chim. et Phys.* III 64: 1-110. [IX. Sur le mode de nutrition des ferments proprement dits, des mucédinées et des vibrioniens, pp. 100-110.]

Peskett, Geoffrey Lewis. 1933. Growth factors of lower organisms, *Biol. Rev.* 8: 1-45.

Pratt, Clara A. 1924. The staling of fungal cultures. II. The alkaline metabolic products and their effect on the growth of fungal spores, *Ann. Bot.* 38: 599-615, *1 fig.*

*Reinke, J. 1883. *Unters. Bot. Lab. Göttingen* 3: 13.

Ritter, G. E. 1909, 1912. Ammoniak und Nitrate als Stickstoffquelle für Schimmelpilze, *Ber. Deutsch. Bot. Ges.* 27: 582-588, 1909; 29: 570-577, 1912.

—. 1914. Ammonnitrat und freie Saltpetersäure als Stickstoffquelle für Schimmelpilze, *Biochem. Zeitsch.* 60: 370-377.

Robertson, R. C. & D. J. Davis. 1923. Food accessory factors (vitamins) in bacterial growth, observations on the ultimate source of accessory growth substances for yeast, *Jour. Infect. Dis.* 32: 153-158.

Sartory, Antoine, R. Sartory, & Jacques Meyer. 1926. Etude de l'action du radium sur l'Aspergillus fumicatus Fresenius en culture sur milieux dissociés et non dissociés, *C. R. Acad. Sci.* 183: 77-79.

—. 1926. La formation des perithèces chez l'Aspergillus fumigatus Fresenius sous l'influence du radium, *C. R. Acad. Sci.* 183: 1360-1362.

Sergent, A. L. 1928. Les facteurs de croissance des microbes sur milieux artificiels, *Thèse Doct. Méd. Paris,* 182 pp.

Talice, Rodolfo V. 1930. Le facteur pH en mycologie. Son influence sur la culture de certaines espèces de champignons parasites de l'homme, *Ann. Parasitol. Hum. Comp.* 8: 183-188, *2 tables.*

Waterman, H. J. 1913. Over eenige factoren, die de ontwikkeling van Penicillium glaucum beïnvloeden Proefschr. Delft. [Über einige Faktoren, welche die Entwicklung von Penicillium glaucum beeinflussen. Beitrag zur Kenntnis der Antiseptica und der Narkose. *Centralbl. Bakt.* II 42: 639-688.]

Went, F. A. F. C. 1901. Über den Einfluss der Nahrung auf die Enzymbildung durch Monilia sitophila (Mont.) Sacc., *Jahrb. Wiss. Bot.* [Pringsheim] 36: 611-664.

CHAPTER III

CULTURE MEDIA, THEIR PREPARATION AND STERILIZATION

Probably the oldest methods of cultivating fungi were developed in growing the common mushroom of commerce (*Psalliota campestris* and related species), but these methods had little, if any, influence on the scientific study and cultivation of fungi. Undoubtedly many mycologists of the nineteenth century brought into their laboratories young fructifications attached to their substrate, and watched their development, also making many important observations on material of early stages collected in the field. It remained, however, for Pasteur and Koch in the decade 1873-1883 to develop methods of sterilization, isolation, and pure culture of bacteria to pave the way for our present technique. Earlier authors in several instances had anticipated these methods more or less completely, but their accounts had either been forgotten, buried under the débris of the theory of spontaneous generation, or lost in a little-known periodical of very limited circulation; e.g., the work of Bizio on *Serratia marcescens (Bacillus prodigiosus)* which was published in 1823 and was only generally known among scientists after its translation and publication in 1924. For a more complete account of the history of bacteriologic methods the reader is referred to the excellent short account in Conn & Conn's *Bacteriology* and, for formulae of the media used to Desgardes (1921) and to Levine and Schoenlein (1930).

In all work with pure cultures it is essential that everything used should be clean and sterile. This statement seems so axiomatic to the well-trained medical man that its emphasis here may appear out of place, but in this generation when so much routine work is left to technicians and even humbler laboratory folk, it may not be out of place. Also in my classes I frequently find students with so little previous training in bacteriology that in the following pages I shall not assume any previous experience in handling microorganisms in pure culture.

The cleaning of glassware, while one of the drudgeries of the laboratory, is very important.* Needless to say the glassware should be washed with soap and water until clean tap water will drain freely from it, and not hang in drops over the sides of test tubes, etc. This stage may be called physically clean. We must then be sure that it is chemically clean, i.e., that it does not contain any substances, minute traces of which may inhibit or cause abnormal growth of the organism to be cultivated.

---

*If the glassware has been used for cultures, it should be sterilized by autoclaving (see pp. 47, 48) before proceeding to wash it. Pautrier and Rietmann (1924) report infection of a laboratory worker with *Trichophyton granulosum* (ordinarily confined to horses) while cleaning tubes containing year-old cultures!

Some new glassware when first received into the laboratory may still contain enough alkali to change considerably the hydrogen ion concentration of the medium to be employed. It may be necessary to heat this glassware with strong acids before using it for careful work, although it may still be used for many of the more tolerant organisms without further treatment. In many laboratories all glassware is treated with a strong oxidizing agent, such as an acid solution of sodium or potassium bichromate, commonly called cleaning solution. This tends to neutralize any free alkali in the glass as well as to destroy any life or organic material. This is especially necessary if dry sterilization of the glassware is expected, as failure to remove all organic material will result in a deposit of carbon which reduces visibility and is almost impossible to remove later, although it probably does not interfere with the growth of the organism.

After treatment with cleaning solution (if necessary), the glassware should be thoroughly rinsed with distilled water. If dry sterilization takes place after hard tap water has been used for rinsing, a deposit of salt may be baked in, causing decreased visibility and, rarely, toxicity. The alternative method of rinsing with the solution to be used is not recommended in ordinary practice, as some liquid may adhere to the top of the tube of the neck of a flask and cause trouble in later procedures.

Sterilization.—Many methods have been developed in the last half century, but none is equally good for everything, consequently the principles underlying each should be thoroughly understood and the proper method selected for the material in hand, with a clear understanding of its limitations.

Chemical Methods (Disinfectants, Antiseptics).—These methods as commonly applied in the laboratory consist in treating the material with a toxic chemical substance for a sufficient time to destroy all life, then removing the chemical substance and preserving the material from further contact with microorganisms until it is used. The methods are difficult and little used when other methods will serve. The chemical nature of the disinfectant must always be considered, as well as its fungicidal power. Disinfectants may be grouped as halogens, salts of heavy metals, and organic compounds.

Halogens.—Fluorine and bromine are rarely used under present conditions. All of the halogens corrode metals and are difficult to handle. They may prove toxic to living tissue, although they are very valuable in some procedures. Chlorine usually is applied as a solution of a hypochlorite which slowly gives off the chlorine in intimate contact with the material to be disinfected. Improvements of this technic have been found useful as antiseptic dressings, disinfection of seeds in laboratory practice, etc. Calcium hypochlorite (bleaching powder, chloride of lime, sodium or potassium hypochlorite) is also used as a deodorant and disinfectant in outhouses and for sterilizing white clothing where other methods are not easily available.

Iodine is usually used in alcoholic or potassium iodide solution or in the organic compound iodoform. This is one of the common disinfectants for superficial lesions but causes unpleasant discolorations and in some individuals severe poisoning. It is rarely used about the laboratory as a disinfectant. The alcoholic solution is occasionally used as a counterirritant.

Salts of Heavy Metals.—In general, salts of heavy metals are toxic to organisms roughly in the order of the magnitude of their atomic weights, although the salt radical has some less clearly defined influence on toxicity. Copper compounds are frequently used in agricultural practice as a fungicide but rarely about the laboratory. Compounds of mercury have had great vogue, especially in some laboratories, but they have some severe drawbacks and probably many may be well replaced by other disinfectants. The oldest and most widely used is mercuric chloride (bichloride of mercury, corrosive sublimate). Toxic in extreme dilution, the solution is apt to dry, leaving tiny crystals which blow about the laboratory and occasionally prevent growth when all other conditions are favorable. Glassware which has been used for mercuric chloride solutions should never be used for cultures again, for if growth takes place at all, it is apt to be abnormal and stunted. In some persons it also causes severe dermatoses extending over several years. The recently developed mercurochrome has eliminated several of these objections.

Silver nitrate (lunar caustic) has long been in use and recently some of the organic silver salts, especially nucleinates (argyrol and similar compounds) have been widely used about the mouth, eyes, and genitalia.

Organic Compounds.—Of the innumerable organic compounds only the lower aliphatic alcohols and aldehydes and the simpler compounds of the aromatic series, such as phenols and salicylic compounds, have found wide use. Methyl alcohol is quite efficient, but is rarely employed on account of the injury of the optic nerve by the vapors. Ethyl alcohol is perhaps the most widely used of the group. Absolute ethyl alcohol has little value, but the intermediate dilutions with water are good, especially for sterilizing cutting instruments which cannot be subjected to heat or to the stronger, but more corrosive, disinfectants. The higher alcohols are little used.

Formaldehyde had a great vogue at one time as a gaseous disinfectant, but now is seldom used about the laboratory, except in aqueous solution (formalin) in seed disinfection and as a cheap preservative for class material.

Phenol (often known in its 4% aqueous solution as carbolic acid) has stood the test of half a century, although its popularity has varied. For many years it was taken as a standard for comparison of the efficiency of antiseptics.

Salicylic compounds belong rather to medicine, although salicylic acid itself is used externally in dermatology as a keratolytic agent.

Volatile oils have been found useful with pathogens of the skin (Kingery et al. 1928, 1929).

Physical Agents.—Heat and light are the only sterilizing agents in general use at present, although it is probable that radiations of still shorter wave lengths would be effective if not so expensive. Light, especially the ultraviolet end of the spectrum, at present belongs rather to the realm of therapeutics than to laboratory practice and need not be considered here, although it may play a great part in hygiene.

Hot dry air is one of the oldest methods employed and is still used for glassware, such as Petri dishes. The clean material, usually heat resistant glass, is put into a gas oven (rarely electric) heated to 150°-180° C. for from a half hour to an hour or more, depending upon the material to be sterilized and the length of time necessary to kill spore-forming organisms which may be found in a given laboratory.

Passing material through a flame for a varying period is also a very old practice, now mostly used for sterilizing inoculating tools, such as needles, platinum spatulas, etc. The metal is ordinarily heated to redness in the flame, then allowed to cool to room temperature without touching any object which might contaminate it until used. The former surgical practice of cautery with red hot iron probably owed its success in part to this method of sterilization. It is obvious that this method is not available for tempered tools, such as scalpels, etc. A variant of this practice is to dip in alcohol and ignite, probably less efficient but adequate in many cases.

Steam.—None of the above-mentioned methods are useful for most culture media, and it was only with the use of steam that culture media in the modern sense began to develop rapidly. Steam may be applied at atmospheric pressure in which case the medium reaches 100° C. and is held at that temperature for a period. This is usually carried out in an Arnold steam sterilizer, a simple apparatus for generating steam with a minimum loss of water during the process. When spores were discovered in bacteria, Tyndall applied this knowledge by proposing discontinuous sterilization, by heating the medium for a definite period, sufficiently long to kill all the organisms in the active vegetative state, then incubating sufficiently long to allow the spores to develop the vegetative stage, and heating again. This process must be repeated until the medium remains sterile on incubation. Under ordinary conditions the usual procedure is to heat in steam at 100° C. for an hour each day for three successive days. If the period between sterilizations is too long, the spores may have germinated and formed new spores, and if too short they may not all have germinated. The long time necessary to prepare media by this method, as well as several more theoretical objections, has tended to eliminate this method from the laboratory. However, some biologic products used as media are profoundly altered by higher temperatures, and it is necessary to employ this method for these substances.

Superheated Steam.—In this method the steam is confined in an autoclave up to any pressure desired, instead of being allowed to escape as in the ordinary steam sterilizer. A good steam pressure gauge on the autoclave is requisite, and a thermometer is not only desirable but also an additional safeguard. The temperature ordinarily employed is 115°-125° C. or about 10-20 pounds pressure per square inch. An exposure to about 120° C. (or 15 lb.) for 15-20 minutes will sterilize most media, unless some very heat resistant organism is present. The period of sterilization must of course be measured from the time the desired temperature is attained and it may require 10-15 minutes, even with a strong heating unit, to reach this temperature.

These temperatures, especially if they are prolonged beyond the minimum necessary to secure complete sterilization, may injure or transform the more labile organic compounds, especially if the acidity or alkalinity of the medium is such as to favor hydrolysis of the higher carbohydrates to hexoses, etc.

The autoclave may be heated by electricity or gas or connected with a steam supply pipe if there is sufficient pressure maintained. Care should be taken to see that sufficient water is present and that the lid is wiped free from dust and dirt before each sterilization. After the autoclave is full of steam and the thermometer registers 100° C., the vent is closed. It is not advisable to leave the autoclave without observation, although if the safety valve is properly set, steam will escape after the desired pressure is reached. As soon as this occurs one may safely cut down on the heat supply, since a rapid escape of steam soon exhausts the small supply of water, and often dislocates the cotton plugs or causes the medium to boil up and wet the plugs. When the necessary time for sterilization has elapsed, the gas is turned off, and the autoclave is allowed to cool until the temperature reaches 100° C. before opening. An experienced operator may open the cock and allow the steam to escape slowly before the pressure is wholly down, but this procedure is not advised for a beginner.

Under field conditions, I have found one of the various aluminium pressure cookers now on the market very useful, although only a comparatively small amount of media may be sterilized at one time.

Filtration.—The passage of the medium through a filter with pores smaller than bacteria is a possible though tedious process which may have to be used in cases where biologic products are so altered by heat that it is impossible otherwise to retain them in condition to use as media.

Asepsis.—The careful excision of bits of plant tissue, under condition of asepsis approaching that obtaining in the operating room of a hospital, with thoroughly sterilized instruments, usually in a special room (culture chamber) where the air is kept relatively free from dust or microorganisms, is sometimes practiced. Such tissues should be incubated for a sufficient time to insure that they have not been accidentally contaminated during their preparation. This method in its simpler form is one of the oldest ways of securing culture media, but is not much used today.

CULTURE MEDIA

Media may be roughly classified as liquid and solid. The former were much used by the earlier workers, but at present are little used except in certain physiologic studies where solids interfere with chemical procedures and in a few other special cases. They are still employed in studies of spore germination.

Liquid Media.—The earlier media were mostly naturally occurring liquids, such as tap water, milk, urine, etc., often with one or more other substances added. Physiologic studies then developed a series of solutions of known chemical composition usually consisting of a basal solution containing all the metallic elements needed for growth and one or more organic compounds containing the requisite sources of carbon and nitrogen. Perhaps the solution known as Czapek's or Dox's solution is more frequently used by mycologists.

Czapek's basal solution:

Distilled water	1000.	c.c.
K_2HPO_4	1.	gm.
KCl	0.5	gm.
$MgSO_4.7H_2O$	0.5	gm.
$FeSO_4$	0.01	gm.

For other useful formulae see Levine and Schoenlein (1930).

Besides a host of formulae of liquid media of definite chemical composition which have been developed in connection with physiologic studies on comparatively narrow ranges of organisms, there are many, both solid and liquid, in common use, in which one or more of the principal constituents are aqueous extracts. These extracts may be classified as infusions and decoctions. Infusions are prepared by allowing the material to be extracted, more or less finely divided, to remain in contact with water, either cold or lukewarm, for a considerable length of time. Hay infusion was one of the very early media of this class but has practically disappeared. Meat infusions are still greatly used in the cultivation of bacteria, although much less important in the cultivation of most groups of fungi. The following directions may be taken as a sample of this type:

Macerate 1 part finely chopped lean meat with 2 parts distilled water in an ice box for 18 hours, stirring occasionally. Strain while cold through a fine cloth. Add 1.0% peptone and 0.5% NaCl to the filtrate. Heat until solution is complete. Add NaOH until the reaction is slightly alkaline (practically neutral to phenolphthalein). Heat on a water-bath for 30 minutes and boil for 5 minutes over a free flame. Filter while hot through paper or cotton and cloth. Add 1.0% of desired nutrients. Adjust reaction as necessary (see p. 38). For the many variants of this method, consult Levine and Schoenlein. Most of the commonly employed media of this type may now be obtained in dehydrated form. In the preparation of these media the directions furnished by the manufacturer should be followed.

Decoctions are usually employed with vegetable substances, as the process is more rapid and rarely are there sufficient proteins to cause trouble. Duggar (1909) proposes that for every 1000 c.c. of water in the decoction the equivalent of 50 gm. dry weight should be used. The plant product is washed, peeled if necessary, thinly sliced, and the necessary water added. It is boiled in a steam sterilizer for 2 hours or placed in the autoclave at 115° C. for 20 minutes, or may be boiled over a free flame for a corresponding period, care being taken that the vegetable does not cook on the bottom of the container and that water lost by evaporation is replaced. The decoction is then strained to remove the larger particles of vegetable and may be filtered through paper. Potato decoctions are very difficult to filter, as further precipitation may follow sterilization.

Solid Media.—Some of the first media of this class were slices or plugs of vegetables, either raw or cooked (during the sterilization process). Some of these substances, such as string beans, prunes, squash, potato, and root crops, are still used in the study of plant pathogens and similar vegetable products have been used occasionally by isolated workers in the tropics without easy access to the more usual types of media. These are frequently very good for producing abundant vegetative growth but less satisfactory for securing reproductive organs.

If the vegetable is to be used raw, it must be carefully washed, the outside thoroughly sterilized by alcohol which is allowed to evaporate or by repeated washing with sterile water in an atmosphere relatively free from dust or spores. Cylinders are then cut out with a sterile cork borer, slightly smaller than the diameter of the test tube to be used, and sliced diagonally. These pieces are then placed either in a special sterile test tube or in a test tube containing one or two glass beads and a small amount of water. If there is no objection to having the vegetable slant cooked, it may be prepared under clean but not necessarily sterile conditions and the whole sterilized together. Glycerol is sometimes added instead of, or in addition to, water in order to insure the surface of the slant remaining moist. Of course the glycerol should also be considered as a possible additional source of carbon.

Rarely bits of meat or fish have been sterilized and used directly as media (Sawyer 1930, Rewbridge, Dodge and Ayers 1929).

The other solid media are all colloidal gels, either silicates, proteins, or carbohydrates. Silicates are somewhat difficult to prepare and are at present principally used where it is essential to know definitely the chemical constituents of the medium in physiological studies or in the rare cases in which the organism is capable of attacking and digesting the medium.

Egg albumen and gelatin are the principal protein media used, mostly in the study of bacteria. Historically, gelatin has been used for a very long time and many of the important early methods and results were obtained with this medium. The directions of Dalmau (1929, 1930) for its preparation are useful, especially for workers in tropical countries.

To 900 c.c. nutrient broth add 200 gm. of gelatin and heat in a water-bath until dissolved. The Bacto Gelatin and Pfanstiehl's brand are highly acid, about pH 3 or 4. Adjust reaction to about 6.5 or any desirable pH, let cool to 50° C., add whites of 2 eggs shaken in 100 c.c. nutrient broth, and bring it rapidly to a boil at 100° C. for 10 minutes in a double boiler with saturated salt solution in the lower compartment. The coagulum should clear the solution. Filter through cotton, or cotton and gauze if necessary. Distribute in tubes and sterilize at 100° C. for 15 minutes on each of three successive days. Cool rapidly after withdrawal from the sterilizer to obtain a hard gelatin, which will not liquefy at tropical room temperatures (28° C.).

At present it is little used except in studies of the ability of organisms to attack and digest protein. Sawyer (1930) has recently used egg yolk with very good results in his work on the Entomophthoraceae, fungous parasites of insects.

The carbohydrate media are chiefly starches and agar. Commercial starches are used, either corn, potato (laundry) or inulin. Ten per cent starch is commonly used and a colloidal solution obtained by short boiling. The medium is tubed and sterilized with or without the addition of salts or other nutrients. The hydrogen ion concentration of the added material should be carefully considered, as any considerable acidity or alkalinity will hydrolyze the starch, defeating the purpose of the medium by preventing solidification and providing sugar. These media have not been widely used on this account. A variant of this medium, in which corn meal mush is prepared, has been employed, although perhaps less frequently than the related corn meal agar. The container is partially filled with corn meal which is then thoroughly moistened with hot water (it is difficult to wet it thoroughly with cold water) and sterilized in the usual manner. This medium is never clear as the starch media may be, but it is easy to prepare, has enough of the inorganic compounds and sources of nitrogen to support growth without further addition, and provides a medium rich in starch.

The agars and similar compounds are complex substances which in part hydrolyze to galactose. They are produced during the metabolism of the marine algae, especially the Rhodophyceae (red algae), and comparatively little is known of their chemical structures. The agar of commerce is largely the product of various species of the Gelidiaceae found on the coast of Japan. It solidifies at a comparatively low temperature (about 40° C.) and melts at a very high one (about 95° C.). The modern sources of supply have improved the quality very much, so that it seldom contains undesirable salts or nitrogenous substances. Naturally, for very careful physiologic work, this point would be checked up before using it. Agar may usually be had in shreds, chopped shreds, or in powdered form. The variant methods of preparing agar found in various laboratories give about equally satisfactory final products. Since the medium carries practically no available nutrient, this is added in the form of a solution, infusion or decoction, or a combination of these. The formulae for these are almost infinite, Levine and Schoenlein recording 803 formulae, not counting the numerous variants in proportions and procedures.

Of these, one of the simplest and perhaps the most widely used in cultivating human pathogens is Sabouraud's conservation agar:

Water	1000 c.c.
Peptone	10 gm.
Agar	18 gm.

Growth is slow on this medium since the peptone furnishes both carbon and nitrogen, but pleomorphism of the dermatophytes is greatly delayed. Personally, following a suggestion of Thaxter who had long experience with other groups of fungi in culture, I prefer to add 40 gm. of agar instead of 18 gm. to media to be used for stock cultures. Growth is extremely slow and the cultures do not dry out so rapidly, both of which conditions are advantageous with routine stock cultures, as the labor of preparation of media and of transfer is greatly reduced.

For isolation and study of the organisms, Sabouraud's test agar (1908), commonly called Sabouraud agar, contains 40 gm. of crude maltose. Sabouraud has been severely criticized for using the crude sugar, as samples vary greatly, one sample used by Sabouraud on analysis yielding mostly glucose (Hodges 1928). For most organisms glucose gives equally good growth, in fact pure maltose is generally poorer. There seems little difference whether 10 or 40 gm. per liter are added. The firm from which Sabouraud secured his maltose ceased business during the World War (1914-1918) and since then, much research has been expended to secure a substitute product which will produce the same giant colonies as those figured by Sabouraud (1910). Sabouraud himself (1925) advocates the use of 8% honey, but again introduces a source of error, since honey varies very much according to the species of bee producing it and the flowers from which it is made; e.g., Berde (1926) failed to secure characteristic colonies on honey made from flowers of *Robinia* or *Stachys annua*.

Weidman & Macmillan (1921) and Weidman (1928) in very extensive studies found that crude glucose gave equally good results, Fairchild's peptone being used instead of Chassaing. This medium is often referred to as the Pennsylvania medium.

Goldschmidt (1924) proposed the following for English laboratories:

Glucose	40 gm.
Agar	20 gm.
Peptone (Fairchild)	10 gm.
Lemco (ordinary not laboratory)	5 gm.
NaCl	5 gm.
Tap water	1000 c.c.

Lemco is an acid meat extract. Ingredients digested in a steamer for 1 hour, adjusted by "soda" to pH 6, sterilized 20 minutes each on 3 successive days.

Gruetz (1923) proposed the following for German laboratories:

Peptone (Knoll)	5 gm.
Nervina Malz from Christiansen, Flensburg	80 gm.
Agar	18 gm.
Water	1000 c.c.

Pollacci (1922) proposed the following for Italian laboratories: 500 gm. ground beef in 1000 c.c. water; cook and filter; add 100 gm. Witte peptone, 5 gm. sodium chloride; heat, filter, warm, and neutralize; heat for half an hour, filter, and add 70 gm. glucose and agar. Bruhns (1928) finds this medium superior to that of Gruetz.

The medium proposed by Macleod (1928) for the cultivation of *Malassezia furfur* is quite similar:

Agar	1.5 gm.
Peptone (Chassaing)	2 gm.
Glycerol	2 c.c.
Glacial acetic acid	1 m.
Distilled water	100 c.c.

Grigorakis (1931) obtained interesting results with 40 gm. of glycerol added to Sabouraud's conservation agar. Benedek advocates 8% crude glucose and peptone (both Merck products). Farley (1920) adds 3-5% human blood heated to 55° C. for 30 minutes to Sabouraud's test agar when cultivating *Epidermophyton*. Gentian violet 1:500,000 is a useful addition to restrain bacterial growth during the isolation of these organisms.

I have found the prepared medium of the Digestive Ferments Company satisfactory as well as media prepared from ingredients furnished by them. Their peptone is too near neutral to reproduce exactly the giant colonies figured by Sabouraud (1910). On the other hand, there is the advantage of greater uniformity of different batches, something greatly to be desired when comparing results secured at different times.

Recently Langeron & Milochevitch (1930) and others have returned to the cereal and dung media, of variable composition, but have secured interesting morphology not produced on the classic Sabouraud medium and its numerous variants. Nannizzi (1926), on the other hand, turned to equally variable animal products, such as bits of skin, nail clippings, horn, feathers, hair, and bone. In this direction the work of Karrenberg (1933) seems to be much the most promising. Using the brain medium of Hibler which was originally developed for anaerobic bacteria, he has maintained stock cultures over very long periods without pleomorphism or loss of virulence. While I have had no personal experience with this medium, it seems so promising that the details of its preparation may be given:

Brains of recently slaughtered animals (within 24 hours) are freed from the pia mater, ground in a meat chopper and weighed. Two parts water to one of brains are added, rubbed through a sieve, and cooked for two hours in a steam sterilizer. The next day the medium is tubed and sterilized in the autoclave. Hach and Karrenberg both suggest 0.85% sodium chloride solution instead of tap water and Karrenberg found the medium satisfactory without rubbing through a sieve.

Independently Grigorakis (1933) has proposed a similar medium based on calf spleen.

Pulp of calf spleen	500 gm.
Peptone	10 gm.
Agar	18 gm.
Water	1000 c.c.

Many workers have reported excellent results with various fungi on carrot agar. The following formula of Falchi may be considered typical:

Carrots	500 gm.
Water	1000 c.c.
Agar	20 gm.
Peptone (Rostock)	10 gm.

Among the formulae for synthetic media, those of Currie (1917) and Fulmer & Grimes (1923) are widely used.

Currie:

Ammonium nitrate	2.5 gm.
Potassium dihydrogen phosphate	1.0 gm.
Magnesium sulphate	0.25 gm.
Carbohydrate	10.0 gm.
Water	1000.0 c.c.
Agar	q.s.

Fulmer & Grimes:

Ammonium chloride	1.88 gm.
Dipotassium hydrogen phosphate	1.0 gm.
Calcium chloride	1.0 gm.
Sucrose	50.0 gm.
Agar	15.0 gm.
Water	1000.0 c.c.

Both formulae have been used in studies of yeasts and fermentation.

Acton & McGuire (1931) report very good results with *Actinomyces* from the medium described by Norris (1929). It consists of:

Soluble starch	2.0 gm.
Dipotassium hydrogen phosphate	0.2 gm.
Calcium chloride	0.05 gm.
Ferric chloride	0.01 gm.
Sodium nitrate	0.06 gm.
Asparagin	0.05 gm.
Agar	20.0 gm.
Water	1000.0 c.c.

The medium is adjusted to pH 7.4.

BIBLIOGRAPHY

Biltris, R. 1929. Sur la variabilité des caractères de l'espèce chez les dermatophytes, *Ann. Inst. Pasteur.* 43: 281-358, *15 figs.*

*Bizio, Bartolomeo. 1823. Lettera di Bartolomeo Bizio al chiarissimo canonico Angelo Bellani sopra il fenomeno della polenta porporina, *Biblioteca Ital. o sia Giornale di Letteratura Scienze e Arti Appendice* 30: 275-295 [anno 8] [translated by C. P. Merlino, *Jour. Bact.* 9: 527-543, 1924].

Bruhns, C. 1928. Einige Bemerkungen über verschiedene Pilzarten und Pilznährboden (Grütz agar, Pollacci agar), *Dermatol. Zeitsch.* 53: 104-112, *4 figs.*

Castellani, Aldo. 1933. The advisability of using in laboratory work sugars tested by microbiological methods, *Jour. Trop. Med. Hyg.* 36: 185, 186.

Conn, H. W. & Harold J. Conn. 1923. Bacteriology, a study of microorganisms and their relation to human welfare, discussing the history of bacteriology, the nature of microorganisms, and their significance in connection with pathology, hygiene, agriculture and the industries, Williams & Wilkins Company, Baltimore, 441 pp.

Currie, James N. 1917. The citric acid fermentation of Aspergillus niger, *Jour. Biol. Chem.* 31: 15-37, *Pls.* 1, 2.

Dalmau, Luz María. 1929, 1930. Observations on mycologic technique with particular reference to pathogenic fungi, *Porto Rico Jour. Public Health Trop. Med.* 5: 302-311, 1930 [tr. Maurice Langeron, Remarques sur la technique mycologique, *Ann. Parasitol. Hum. Comp.* 7: 536-545, 1929].

Descouraux, J. M. C. M. 1926. Contribution à l'étude de nouveaux milieux de culture pour les dermatophytes, *Thèse. Fac. Pharm. Univ. Strasbourg* 24: 72 pp., *2 pls.*

Desgardes, Deribère. 1921. Formulaire des milieux de culture en microbiologie, Paris, Le François, 98 pp.

Dessy, G. 1933. La chimiothérapie des mycoses. III. Mucormycose 1, Expériences in vitro, *Soc. Internaz. Microbiol. Boll. Sez. Ital.* 5: 95-107; 2, Expériences in vivo, *Ibid.* 5: 201-206.

Duggar, Benjamin Minge. 1909. Fungous diseases of plants, with chapters on physiology, culture methods and technique, Boston, Ginn & Company, 508 pp.

Egyedi, Henrik. 1922. Zur Reinkultivierung der pathogenen Schimmelpilze, *Centralbl. Bakt.* I, 87: 562-564.

Farley, David L. 1920. The use of gentian violet as a restrainer in the isolation of pathogenic molds, *Arch. Derm. Syphilol.* 2: 459-465, *2 figs.*

Fulmer, E. I. & M. Grimes. 1923. The growth of yeasts on synthetic agar media, *Jour. Bact.* 8: 585-588.

Goldschmidt, W. N. 1924. A new medium for the growth and differentiation of the dermatophytes, *Brit. Jour. Derm.* 36: 204-206.

Grigorakis, L. 1931. L'action des milieux glycérinés sur le mycélium dégradé par le pléomorphisme, *C. R. Soc. Biol.* 108: 94-96.

—. 1933. Sur un nouveau milieu de conservation des dermatophytes (pléomorphisme, caractère acquis, spécificité tissulaire, *C. R. Acad. Sci.* 196: 60-62.

Grütz, O. 1923. Beiträge zur Kultur der Dermatophyten und ihrer Artunterscheidung mittels deutscher Pilznährboden, *Derm. Wochenschr.* 76: 568-573.

Hodges, R. S. 1928. Cultures of ringworm fungi on Sabouraud's proof mediums and on mediums prepared with American peptones and sugars, *Arch. Derm. Syphilol.* 18: 852-856.

Karrenberg, C. L. 1933. Untersuchungen über Wachstum und Konservierung pathogener Hautpilze auf Hirnbrei nach v. Hibler, *Arch. Derm. Syphilis* 168: 438-475, *10 figs.*

Kingery, Lyle B. 1929. Thymol and cinnamon oil in the treatment of ringworm of the scalp, *Arch. Derm. Syphilol.* 20: 797-805.

Kingery, Lyle B. & Alva Adkisson. 1928. Certain volatile oils and stearoptens as fungicides, *Arch. Dermatol.* 17: 499-511, *9 figs.*

Langeron, Maurice & S. Milochevitch. 1930. Morphologie des dermatophytes sur les milieu naturels et milieux à base de polysaccharides (Note préliminaire), *Ann. Parasitol. Hum. Comp.* 8: 422-436.

Levine, Max & H. W. Schoenlein. 1930. A compilation of culture media for the cultivation of microorganisms, *Monographs on Systematic Bacteriology* 2: xvi + 969 pp.

Macleod, J. M. H. 1928. An experimental study of the Pityrosporon of Malassez: its morphology, cultivation and pathogenicity, *Brit. Jour. Derm. Syphilis* 40: 139-148.

Nannizzi, Arturo. 1926. Ricerche sui rapporti morfologici e biologici tra gymnoascacee e dermatomiceti, *Ann. Myc.* 24: 85-129, *6 pls., 12 figs.*

Pautrier, L. M. & B. Rietmann. 1924. Trichophytie cutanée à forme d'épidermophytie dues au Trichophyton granulosum, et provoquée par une infection de laboratoire, *Bull. Soc. Franc. Derm. Syphiligr.* 31: Reunion Strasbourg, 29-31.

Pollacci, Gino & Arturo Nannizzi. 1922. I miceti patogeni dell'uomo e degli animali descritti, delineati e preparati per l'osservazione al microscopio con notizie sopra i rimedi per combatterli. 1: prefazione. Siena.

Rewbridge, Allan G., Carroll William Dodge & Theodore T. Ayres. 1929. A case of meningitis due to Endomyces capsulatus (new species), *Am. Jour. Path.* 5: 349-364, *Pls. 71-73.*

Sabouraud, Raimond. 1908. Milieux de culture des champignons dermatophytes (Technique de fabrication des géloses sucrées dites: Milieux d'épreuve), *Ann. Derm. Syphiligr.* IV, 9: 99-101.

—. 1925. Note sur le remplacement de tout sucre dans les milieux de culture des dermatophytes par le miel d'abeilles, *Ann. Derm. Syphiligr.* VI, 6: 515-517.

Sawyer, William H. 1929. Observations on some entomogenous members of the Entomophthoraceae in artificial culture, *Amer. Jour. Bot.* 16: 87-120, *4 pls.*

Weidman, Fred D. 1928. Comparison of ringworm culture ingredients. II. The nitrogen factor, *Arch. Derm. Syphilol.* 18: 829-837.

Weidman, Fred D. & Thomas M. Macmillan. 1921. A comparison of ingredients of ringworm culture mediums with special reference to American and French crude maltose, *Arch. Derm. Syphilol.* 4: 451-468, *16 figs.*

Weidman, Fred D. & Dorothy Spring. 1928. Comparison of ringworm culture ingredients. III. Grütz, Goldschmitt, Sabouraud (honey modification), Sabouraud's glycerin and certain synthetic mediums, *Arch. Derm. Syphilol.* 18: 837-850.

CHAPTER IV

ISOLATION OF MICROORGANISMS

Transfer.—This is perhaps the simplest process connected with the handling of organisms in culture and should be practiced by the beginner until the operations can be performed quickly and entirely without contaminations before more complicated procedures are attempted. Essentially the process consists in taking a small amount of mycelium or spores of fungi or a few bacterial cells and moving them from one receptacle of medium to another. The test tube containing the culture of the organism to be transferred and a tube of medium are held about half an inch apart between the thumb and fingers of the left hand with the thumb above. The plugs of both tubes are loosened in turn with a rotary motion, but not withdrawn. The transfer needle, loop, or platinum spatula, as the case may be, is grasped between the thumb and first finger of the right hand, the platinum is heated to redness in a blue flame and allowed to cool while still in the hand and without the heated portion touching anything. The cotton plug of the tube containing the organism to be transferred is grasped between the second and third finger of the right hand and gently withdrawn, care being taken to create as few air currents as possible. A needle or loop is inserted without touching the walls of the tube and touched to the spores or to the vegetative material if it is slimy, or a platinum spatula is used to cut away a little mycelium which should adhere to it. The needle is then gently withdrawn, the plug replaced and the other plug withdrawn, and the needle stroked along the surface of the agar (or the mycelium dislodged from the spatula). The needle is then gently withdrawn, the second plug replaced, and the needle (or spatula) flamed before laying it down, to destroy any organisms still adhering to it. The plugs may then be pushed in more firmly if necessary. In some laboratories it is customary to flame and quickly extinguish the cotton plugs.

Isolation.—The simplest procedure is similar to simple transfer in which the needle or spatula is touched to the infective material and then transferred to the surface of agar in a test tube or Petri dish. This method is only occasionally successful, usually in those cases where the infective material is small and uncontaminated by other organisms than the one which it is desired to study. If contamination is only slight, a carefully executed transfer from the colony which is desired may result in securing a pure culture. Otherwise, resort must be had to dilution and plating out.

Isolations From Skin Lesions.—After cleansing the skin with 95% alcohol followed by ether, the lesion is scraped with a sharp, full-bellied, sterile scalpel or shaved with a sterile safety razor to the point where bloody serum just begins to ooze. A sterile Petri dish is placed beneath to catch the scrapings, or, if they do not fall away readily, they are scraped off the blade into the Petri dish by another blade. On reaching the laboratory, a few scales are removed for microscopic examination after maceration in 40% KOH or some other similar treatment. Then a very thin film of Sabouraud maltose or glucose agar is poured into the plate containing the scales and detritus. Thus, the latter are caught by the nutrient medium and held. To reduce chances of bacterial contamination the scales may be moistened with alcohol for a short time, but this does not prevent the growth of some of the hardy saprophytes and may inhibit the growth of the more delicate pathogen.

As soon as the colonies are visible to the naked eye, the suspicious ones are marked with a glass-writing pencil, each being given a serial number. The marked colonies are then transferred to Sabouraud's sugar medium on slants and to the conservation medium (without sugar). This transfer is made early to prevent overrunning by the rapidly growing contaminants, such as *Aspergillus* and *Penicillium,* which may be present.

Isolations From Feces, Tongue Scrapings, etc.—Poured plates are allowed to harden and then 25 points of contact are made in each with a platinum loop repeatedly soiled with the infective material. After about four days, when the colonies have developed, these are fished. In this way the percentage of points of contact of material with the medium which contains similar colonies gives a rough idea of the abundance of colonization in the material. (Dalmau 1930.)

In connection with their studies with sprue, Weiss & Landrón (1928) suggest as follows: Emulsify a small quantity of feces in a test tube of sterile distilled water and also in another tube containing whole ox bile in which has been incorporated 20% concentration of glycerol. By means of a glass rod bent at an angle of 30° a drop of each fecal suspension is spread over the surfaces of the plates of Sabouraud agar (pH 6.3) containing 4% glucose and 20% glycerol; incubate at 35° C.

Dilution.—About three tubes of agar (or other liquefiable medium) are heated gently on a water-bath (porcelain or glass beaker) until the agar melts. It is then allowed to cool until the end of the tube containing the agar can be held against the back of the hand without causing pain, i.e., until the solidifying point is almost reached. The tube is inoculated by the method suggested in simple transfer. After laying down the needle, the tube is rapidly rolled between the palms, while it is in a vertical position, to mix the contents thoroughly and scatter the inoculum. The loop is used to transfer a tiny drop of the molten medium to the second tube two or three times. This in turn is rotated, etc. The contents of the three tubes are then poured successively into three Petri dishes lying on a level surface. If the agar fails to wet the surface of the dish completely, the dish is tipped slightly to allow the agar to flow over the whole surface of the bottom. It is then allowed to solidify and is incubated bottom side up until growth is evident. Then individual colonies are transferred to slants. Sometimes it is necessary to repeat this process. In the above-mentioned processes it is desirable to work gently in order to set up as few air currents as possible, never to lift the cover of the Petri dish higher than necessary to insert the test tube for pouring, and to keep the test tubes plugged as much as possible. As soon as the agar is poured from the tubes, they should be lowered into a dish of water and boiled as soon as possible, both to kill the organism which may have adhered to the agar still in the test tube and to clean them before the agar has a chance to dry on.

Inhibitors.—To keep back the rapidly growing organisms and allow the slower growing ones to develop, various substances may be added to the medium first used in isolation. Advantage is often taken of the fact that some groups of fungi grow at different hydrogen ion concentration from others. In these methods, varying small amounts of lactic or other organic acids are added to the medium to inhibit the growth of bacteria. Sometimes dyes are also used for this purpose, e.g., ''gentian violet'' (probably methyl violet) 1:500,000 (Farley 1920) or to indicate the presence of a small colony before it has developed sufficiently to be seen otherwise in order that it may be fished before it has been overgrown by a more rapidly growing organism. Indicators are very useful in this way if the organism one desires to isolate produces acid or alkali in the medium. Usually these special methods have been developed in connection with an intensive study of a single organism and are rarely useful unless the presence of a given organism is strongly suspected. Slight amounts of organic acids are useful, however, in keeping down rapid bacterial growth while waiting for the more slowly growing fungi to develop.

Similarly, the choice of suitable media may do much to favor selectively the development of one organism while retarding another. No general rules can be given for these choices since they are largely the result of wide experience and a shrewd guess as to the probable organism to be isolated. A thorough knowledge of the physiology of the various groups of fungi will be helpful, but in the present state of our knowledge generalization is very difficult.

Microcultures.—In the study of the life cycle of many organisms it becomes desirable to have a given spore or bit of mycelium under more or less continuous observation with the microscope. One of the early methods which has yielded much useful information is the hanging drop culture. An early and inexpensive form, usually referred to as a Van Tieghem cell, consists of a glass ring cemented to a microscopic slide with wax (made by melting together pure beeswax and vaseline). The top of the ring is coated with vaseline. A drop of the culture medium or water is placed in the bottom of the cell thus formed. Another smaller drop is placed upon a clean cover slip of sufficient diameter to cover the ring. The inoculum is then placed in the center of this drop, and the whole seized by forceps and quickly inverted, care being taken that the drop does not spread too near the edge of the cover during the process. The cover (with the drop of medium or water hanging from it) is then lowered to the glass ring and pressed down gently until the soft vaseline (petrolatum) seals it to the ring. Thus we have a small moist chamber with the organism suspended in a drop from the cover. The drop placed in the bottom of the cell prevents drying out, since its vapor pressure is practically the same as that of the hanging drop. The cell may be placed on the stage of a microscope and studied from time to time until the nutrient material in the drop is exhausted. One should be careful not to have the drop too large, since it will be difficult to focus to the bottom of it if the spore under observation should not be thoroughly wetted and lies in the surface layer of the drop, or is so heavy that it falls to the bottom of the drop. To avoid this, sometimes a thin film of agar is used instead of a liquid drop, in which case distilled water is usually placed in the bottom of the cell to prevent drying out. Sometimes a very young colony with a small amount of the surrounding agar is cut out and placed on the cover glass, making a hanging block culture described by various authors including Dalmau (1929-1930). Studies made by these methods are especially valuable in following the early stages in the development of a spore or in the evolution of the life cycle. Various types of hollow-ground slides, etc., have been developed, but for convenience and general use, they have little advantage over an ordinary Van Tieghem cell.

Giant Cultures.—At the other extreme from the microculture, we may use giant cultures. These colonies which are allowed to develop over a long period on an abundant supply of substrate, are very useful in giving gross morphology on various media and often are strikingly characteristic in appearance for different species. They have had little favor in most laboratories, as they must be allowed to grow from one month to two or three before this character can be ascertained. However, they have been utilized with very excellent results by Sabouraud and others in the dermatophytes and by Lindner in the yeasts. Since, under ordinary conditions a Petri dish is too shallow to hold sufficient medium, and allows it to dry out too readily and also to be subject to contamination, various specialized culture dishes have been devised. Perhaps the Roux flask, of which there are several types on the market, is the best known, although somewhat expensive. Ordinary cultures in Erlenmeyer flasks are satisfactory for most purposes, but they do not admit of either microscopic examination or photography without breaking the flask, which is frequently difficult to do without injury to the colony. To obviate this for photographic purposes, Shrewsbury (1931) suggests growing them in green glass medicine bottles of 10-12-ounce capacity (with flat sides if possible). The bottle may be evenly broken by application of a red hot nail along the sides. These bottles are also useful for growing cultures under diminished pressure since the glass is strong enough to resist almost complete exhaustion. He also suggests their use in exposing the inverted colony to fumes of various antiseptics, such as ethyl iodide.

Karrenberg has suggested two ingenious devices which permit giant colonies to be photographed or studied with the low power of the microscope with a minimum chance for contamination. In 1926 he suggested an inner test tube carrying an agar slant from which the side had been removed. This was stored in a somewhat larger test tube plugged with cotton. When it is desired to photograph or to examine the colony, the inner tube may be easily removed and if care is taken to work in a relatively dust-free atmosphere, often several examinations may be made before the colony becomes contaminated. The size of the colony is rather limited in this device. In 1927 he proposed a more elaborate flask. It is essentially a flask of the Erlenmeyer type, made in two pieces, a lower portion to hold the medium and a cover fitting over it rather more closely than the usual Petri dish cover. The pieces are held together by a metal plate underneath and a ring around the neck of the flask connected by three springs which hook into the upper ring to provide sufficient compression to prevent contamination. The flask is manipulated as an ordinary flask, the neck being plugged with cotton. After the colony is grown, the springs are unhooked from the ring and the top is lifted off. If care is taken in the examination, little contamination results. So far as I am aware, this type of flask has not been placed on the market.

Single Cell (Spore) Cultures.—Finally, there comes a time in the study of many fungi when the results of a study of cultures made by the above-mentioned methods are ambiguous, and it becomes desirable to work with mycelium and spores produced by a single spore in order that problems of sexuality or homothallism and heterothallism may be investigated, or that the relationships of apparent stages in a life cycle may be studied and verified. The problem has been variously met by different investigators, depending somewhat on the size and nature of the spore to be isolated and the instruments available for the work. If the spores are large and the hand is very skillful, it may be possible to pick up a single spore on a needle under the low power of the microscope and transfer it to a sterile tube or a hanging drop. Various mechanical devices have been developed to aid in this work, e.g., the old Barber spore picker or pipette or some of the modern micromanipulators used in microdissection studies. In these devices, motion is secured by means of micrometer screws, and the spore is usually sucked into the end of a tiny pipette made by drawing out a piece of glass tubing to an inside diameter only slightly larger than the spore or cell to be isolated. This is then discharged into a hanging drop or a sterile culture tube. For detailed directions, those accompanying the instruments should be consulted.

Ascospore Detection.—Since classification is based primarily upon the spore forms resulting from the sexual act (caryogamy), every effort to secure the sexual or perfect stage should be made before relegating an organism to the large heterogeneous group known as the Fungi Imperfecti. There is no single method which is equally successful for all organisms, nor even for members of a single group.

Perhaps patience is the first requisite. Frequently one finds evidence of sexuality by a diligent search of a colony 3-4 months old, after the agar has begun to dry. This seems very useful in the filamentous yeasts whose imperfect stage is usually placed in the genus *Monilia*. Some media seem better than others, but usually a careful search will show traces of sexuality on most media upon which the organism has made a good growth. This method is very tedious, especially among pathogens when the physician wishes a prompt diagnosis, at least to a genus name, and seems puzzled if the mycologist promptly reports that he has a species of *Monilia* and 2 or 3 months later changes his report to *Zymonema*.

Among the true yeasts, several methods are in vogue, none of which is uniformly successful, but all of which may sometimes produce results. All should be tried before placing an unknown organism in the large and poorly defined genus *Cryptococcus*. Stelling-Dekker (1931) has summarized these methods and in most cases traced the method to the original author. The oldest method is that of Engel (1872), popularized by Hansen (1883), where the cells from an actively growing colony are scraped off and placed on a sterile block of plaster of Paris (gypsum) which is kept moist by sterile water, or malt extract (Klöcker 1924) or by mannitol-phosphate solution (18 c.c. 2% mannitol + 2 c.c. 5% dipotassium phosphate) (Saito 1923). Gorodkova (1908) reported the use of an agar rich in nitrogen and poor in carbohydrate which usually bears her name. Distilled water 1000 c.c., agar 10 gm.,* peptone 10 gm.,* beef extract 10 gm., sodium chloride 5 gm., and glucose 2.5 gm. Various French authors, notably Guilliermond, have advocated the use of slices of carrot or potato. Beijerinck(1898) advocated the use of plain agar to which no nutrient had been added and which had been thoroughly washed to remove impurities which might possibly be a source of food.

Wagner (1928) has made a more thorough study of conditions initiating ascospore formation. He emphasizes the importance of the sugars previously used in cultivating the organism and the hydrogen ion concentration of the medium. Kufferath (1928) attributes the success of his medium to its alkalinity. He prepares it as follows: Malt meal is hydrolyzed with sulphuric acid, the acid neutralized with calcium carbonate, and the agar added. It is then brought to the desired alkalinity with sodium hydroxide. In 1930 he studied the matter further. He found that in general the usual concentration of gelatin (15%) is as successful as higher concentrations. He studied the effect of alkalinity and found it rather more successful than acidity in producing ascospores, but occasionally the reverse is true. Before one can be certain that spores are not formed, one should try all the methods.

Fermentation.—Another character to which some authors have attached much importance in some groups is ability to ferment or to utilize certain sugars. The term "fermentation" is used very loosely by various writers. Some, as Stelling-Dekker, would practically restrict it to the production of alcohol and carbon dioxide from a hexose, while Castellani would include all cases in which acid or gas appears in a carbohydrate-containing medium on which an organism has developed. It is probable that this different use of the term has occasioned much difference of opinion in regard to the fermentative ability of a species. A further source of error is almost inherent in the methods in ordinary use, each of which indicates an equilibrium of several possible reactions, hence it is important to state clearly what method was used in determining fermentation if this character is to have meaning in the separation of species. In the following discussion of methods, an attempt will be made to point out some of the sources of error and objections raised to each method. As in many other organic reactions, details of method often profoundly influence the point of equilibrium.

---

*Maneval (1924) recommends the omission of peptone, addition of 15 or 20 gm. agar, and reduces Liebig's meat extract to 3 gm.

Lindner's Microfermentation Method.—A hollow-ground microscopic slide is flamed and filled with sterile water. A relatively large number of yeast cells is suspended in the water and a pinch of the sugar to be tested is added. A cover glass is carefully lowered so as to exclude any air bubbles and sealed in place with lanolin or vaseline. This is placed in an incubator for 24 hours at the optimum temperature and the presence of bubbles (supposedly of carbon dioxide) noted. In this method it is assumed that there will be comparatively little growth and consequent production of CO_2, due to absence of oxygen and the lack of nutrients. The amount of gas should be roughly proportional to the amount of the inoculum. If the organism ferments very slowly and a larger quantity of inoculum is used, the amount of glycogen transferred with the yeast cells and that diffusing out of the dead cells may be sufficient to give gas production. Since the sugar is not sterilized, there is always a possibility of introducing some fermenting bacterium. Also there is a possibility that the seal is not tight and that subsequent evaporation may give the appearance of gas production or may allow the gas to escape. Changes of temperature or of atmospheric pressure may also give erroneous results. Guilliermond modified the method by filling a Van Tieghem cell with a relatively large volume of liquid, and dissolving the sugar in a definite concentration in a yeast decoction. This modification presupposes that the yeast may grow, and consequently the CO_2 may be partly the result of respiration rather than fermentation in the strict sense of the word, especially as there may be dissolved oxygen in the liquid.

The Fermentation Tube Method.—In this method, bent tubes of varying pattern, perhaps originally used by Einhorn in 1885 but introduced into microbiology by Theobald Smith in 1890, are filled with a sugar solution and sterilized. The amount of liquid should be sufficient to slightly more than fill the long arm but not so much as to wet the plug. This is inoculated with the organism and set aside in an incubator until the organism has grown long enough to develop gas. If the long arm is graduated, the volume of gas produced may be noted. Since the surface of the liquid in the long arm is not exposed to free oxygen, strict anaerobic conditions are maintained. Also, if the organism is strictly aerobic, it grows only in the short arm, and there is not enough growth in the long arm to show fermentation, even if the organism is capable of producing it. On the other hand, since the carbon dioxide is quite soluble in the solution, small amounts are dissolved and do not show up. There is also the problem as to the source of the gas, whether it is from fermentation or respiration. Aichelburg (1932) reports that gas production in fructose shows on the third day while glucose shows on the first day.

The ideal method would be one in which the reaction was studied quantitatively in special apparatus, a condition not attained except in purely physiologic researches (cf. Kluyver 1914).

Since comparatively few organisms ferment hexoses to carbon dioxide and alcohol, in the majority of cases we are really interested rather in the ability of the organism to attack and utilize sugars than in their fermentative ability in the narrow sense of the term. Hence, a quantitative titration of the sugar medium for the presence of accumulated acid is equally useful. In fact, in the majority of ''fermentations'' mentioned for *Monilia* by Castellani, the production of acid rather than of alcohol is meant. Probably this has been done very roughly, since the author rarely mentions the indicator used and never the relative amount of sugar converted to acid in a unit of time by a definite number of organisms per cubic centimeter. Stelling-Dekker suggests that more quantitative methods are useful, especially in the case of a trisaccharide in which several organisms secrete raffinase which by hydrolysis splits the raffinose to mellibiose and fructose and is able to ferment the fructose so produced but not to hydrolyze the mellibiose. Aichelburg (1932) reports that slight acidity shows after one week with inulin but only after two weeks with starch. For further consideration of the problems involved, especially of the chemical reactions, the reader should consult some of the standard works on biochemistry, or special monographs on alcoholic fermentation, such as that by Harden. Maltose, fructose, and glucose are quite regularly fermented by many species of yeasts while galactose, sucrose, and dextrin are more variable. Inulin, raffinose, and mannite are often attacked by certain species and should be tried in placing a strange *Monilia*. Lactose is attacked by comparatively few fungi, but when it is attacked the amount of fermentation is apt to be large. Most of the other sugars are too rarely fermented and too expensive to be used in most routine work. Ashford has shown that ultraviolet light may destroy the normal fermenting power of *Syringospora psilosis (Monilia psilosis)*.

Sometimes characteristic deposits may be evident upon cultivation in connection with fermentation studies. Ashford's laboratory usually tests fermentation on 1-4% concentration of the sugar in peptone water, although nutrient bouillon may be used. The pH is adjusted to about the neutral point, and changes of acidity or alkalinity are noted.

Animal and Human Inoculations and Recovery of Organisms From Lesions.—The methods used for inoculations, both of animals and human volunteers, are too well known by the medical profession to need discussion here, and have little value in the hands of an experimenter without a good medical training. The necessity of a thorough sterilization of the skin cannot be too strongly emphasized, for mold spores from dust or clothing may be picked up as a contaminant and, in some cases, even be considered as the etiologic agent. Perhaps the advice of Erwin F. Smith needs especial emphasis in this connection. ''I now endeavor to repeat all my own experiments several times over and in the end I have a rounded out and better view than the one series only could possibly give me. Incidentally, I usually succeed in eliminating some errors or half truths which appertained to the first experiment."

BIBLIOGRAPHY

Beijerinck, M. W. 1898. Über Regeneration der Sporenbildung bei Alkoholhefen wo diese Funktion im Verschwinden begriffen ist, *Centralbl. Bakt.* II 4: 657-663, 721-730, *1 pl.*

Benedek, Tibor. 1926. Über directe mikrospische Beobachtung von Reagensglas Pilzkulturen und ihre Verwendungs möglichkeiten, nebst Angabe von neuen Mikroskop Objekt Tisch-Klemmen für Mykologische Arbeiten, *Derm. Woch.* 82: 1-5.

Dalmau, Luz María. 1929, 1930. Observations on mycologic technique with particular reference to pathogenic fungi, *Porto Rico Jour. Public Health & Trop. Med.* 5: 302-311 [tr. M. Langeron, Remarques sur la technique mycologique, *Ann. Parasitol. Hum. Comp.* 7: 536-545, 1929].

Dekker, N. M. Stelling. 1931. Die Hefesammlung des "Centraalbureau voor Schimmelcultures." Beiträge zu einer Monographie der Hefearten. 1. Die Sporogenen Hefen, *Verhandel. K. Akad. Wetensch. Amsterdam. Afdeel. Natuurk.* 28:1: 1-547, illus.

Engel, L. 1872. Les ferments alcooliques, *Thèse Paris* 336: 1-62, *1 pl.*

Farley, David L. 1920. The use of gentian violet as a restrainer in the isolation of pathogenic molds, *Arch. Derm. Syphilol.* 2: 459-465, *2 figs.*

Gilchrist, T. Caspar & William Royal Stokes. 1898. A case of pseudolupus vulgaris caused by Blastomyces, *Jour. Exp. Med.* 3: 53-78, *Pls. 4-8.*

Gorodkova, A. A. 1908. O bystrom poluchenii spor u drozhzhevykh gribov, *Bull. Jard. Imp. St. Petersbourg* 8: 165-170.

Grigorakis, Léonidas. 1933. Sur un nouveau milieu de conservation des dermatophytes pléomorphisme, caractère acquis, spécificité tissulaire, *C. R. Acad. Sci.* 196: 60-62.

Hansen, Emil Christian. 1883. Undersøgelser over alkoholgjaersvampenes fysiologi og morfologi, *Meddelelser Carlsberg Laboratoriet* 2: 29-102; 152-210; 220-256 [in French 13-59; 92-136, 142-157]. Ges theor. Abhandl. u. Garungsorganismen, 125-169, 1911.

Karrenberg, Karl Ludwig. 1926. Ein neues Röhrchen der Züchtung von Dermatophyten und Bakterien, *Derm. Zeitschr.* 49: 248-252.

—. 1927. Ein neuer Kolben zur Züchtung und Aufbewahrung von Pilzkulturen, *Derm. Woch.* 85: 1706-1708.

—. 1927. Die Eignung der von Grütz angegebenen Nährböden zur Bestimmung und Weiterzüchtung der Dermatophyten, *Derm. Woch.* 84: 434-439.

—. 1933. Untersuchungen über Wachstum und Konservierung pathogener Hautpilze auf Hirnbrei nach v. Hibler (Vorläufige Mitteilung, *Arch. Derm. Syphilis* 168: 438-475, *10 figs.*

*Klöcker, A. 1924. Die Gärungsorganismen ed. 3.

*Kluyver, A. J. 1914. Biochemische Suikerbepalingen. Delft.

*Kufferath, H. 1928. *Ann. Soc. Zymologie* 1: 214.

*—. 1930. *Ann. Soc. Zymologie* 2: 33.

Mallinckrodt-Haupt, Asta St. v. 1926. Vitalfärbung mit Indicatorfarben bei Hyphomyceten, I, *Derm. Zeitschr.* 46: 293-305.

Maneval, W. E. 1924. A method of securing spores of yeasts, *Bot. Gaz.* 78: 122, 123.

Saito, Kendo. 1923. Beschreibung von zwei neuen Hefearten nebst Bemerkungen über die Sporenbildung bei Torulaspora, Delbrücki Lindner, *Bot. Mag. Tokyo* 37: 63-66, *2 figs.*

Shrewsbury, J. F. D. 1931. Giant colony culture, *Jour. Path. Bact.* 34: 283-285, *Pl. 15.*

Wagner, Felix. 1928. Der Einfluss der Zuckerarten und der Wasserstoffsionenkonzentration auf die Sporulation der Saccharomyceten, *Centralbl. Bakt.* II 75: 4-24, *5 figs.*

Weiss, Charles & Francisco Landrón. 1928, 1929. Immunological investigations of tropical sprue in Porto Rico, 1-3. *Am. Jour. Trop. Med.* 9: 83-95, 1929. 4. Biology of Monilia psilosis in relation to sprue, *Jour. Infect. Dis.* 43: 557-564, 1928.

MARINE BIOLOGICAL LABORATORY
WOODS HOLE
LIBRARY
MASS.

CHAPTER V

MICROSCOPY

BY MORRIS MOORE

To one acquainted with the cultural characteristics of various groups of fungi, it is easy to recognize the larger groups, but for accurate diagnosis a microscopic study of the morphology of the organisms is necessary. The fungus must be allowed to grow for a sufficient length of time to permit important morphologic characters to develop. If the organism is pathogenic, all the precautions mentioned for transfer must be taken to insure that spores of dangerous microbes are not detached to float in the air and perhaps inoculate some one. The slide and cover should be thoroughly cleaned with acid alcohol and passed through a flame to remove any traces of fat. In dislodging the material to be studied, great care should be taken not to entangle unnecessarily the mycelium. With yeastlike fungi this latter step is simplified, since it is necessary only to take a loopful of the culture without fear of entangling the mycelium as may occur with filamentous forms.

The mounting of the material should be done carefully. A drop of distilled water, alcohol, Amann's lactophenol preparation, or glycerin, either with or without a stain, is placed in the center of the slide. The fungus is then lifted carefully from the tube with a platinum or nichrome needle or spatula, dislodged into the drop, or pushed off by another needle if not pulled off by the surface tension of the mounting medium. Platinum is preferable to nichrome because of its rapidity in cooling, but nichrome is a harder metal and is better for thick, hard growths which resist elevation by the needle. The material is spread out as gently as possible in the mounting medium and a cover glass is lowered carefully on the preparation, avoiding the inclusion of bubbles of air. Alcohol has the advantage of killing the organism, and, having a low surface tension, does not dislodge spores badly. It also has a tendency to form fewer air bubbles, but it soon dries out and must be replaced quite promptly by water or water and glycerol (2 parts water and 1 part glycerol). This is done by placing a drop on the slide next the cover glass and allowing it to be drawn in under as the alcohol evaporates. Care must be taken, if glycerol is used, that it does not wet the top of the cover glass, as it will be difficult to remove later. The disadvantage in the use of glycerol alone lies in the fact that yeastlike or even filamentous forms may be cleared to such an extent that it is very difficult to make out the morphology of the organism. To avoid this, various dyes, such as methylene blue, crystal violet, or eosin, are incorporated either as an aqueous or alcoholic solution (usually about 1%) in amount sufficient to produce the desired intensity. Water does not evaporate rapidly, but, owing to its high surface tension, tends to tear away spores from their attachments and, in general, is rather unsatisfactory for filamentous fungi, although it is very satisfactory as a mounting medium for most yeast and yeastlike organisms. Some of the various formulae of lactophenol give good results, as does also lactic acid alone. The latter has the disadvantage of preventing the use of many dyes in staining.

So far as I am aware, lactophenol was developed in French laboratories, the formula of Amann (1896) being phenol crystals 20 gm., lactic acid 20 gm., glycerol 40 gm., and distilled water 20 gm. These are dissolved with gentle warming and then is added anilin blue (a mixture of the tri-sulphonates of tri-phenyl pararosanilin [C.I.706] and of di-phenyl rosanilin) otherwise known as cotton blue (C. B. Poirier). Other compounds, such as methyl blue, are also called cotton blue, but are said to be distinctly inferior for this purpose. Sartory (1924) recommends 0.5% dye to his lactophenol. Linder (1929) advocates the same formula while Henrici (1930) adds only 0.05% of the dye. I have found that the dye added directly to the lactophenol gives a blue background to the preparation. Consequently, I use a 1% aqueous solution of cotton blue, place a drop on a clean slide, inoculate with the fungus, lower a cover glass on the mount, and then allow a drop of lactophenol to be drawn in under as shown previously for glycerol. By this method, the excess dye is pushed to the edge of the cover slip and the lactophenol forms a clear background for the blue fungus.

Weston (1929) recommends the addition of a small quantity of nigrosin, water soluble, either aqueous, or the picric acid solution described by Curtis and Colley (1915) in order to stain nuclei as well. Since the dye varies in different samples, at present Weston has found no other way than to add some of the dye, try it, and then add more dye or more lactophenol until satisfactory results are obtained. Sartory also recommends a mixture of Sudan III 1 part, and lactic acid 1000 parts by weight. This is ground in a mortar with slow additions of small amounts of the lactic acid. The mixture is then heated in a flask on a water-bath until it is completely dissolved, cooled and filtered. One part of anilin blue is added, also 1-2 drops of tincture of iodine for each 10 c.c. of solution. This triple stain colors fatty bodies, amyloid compounds, and the fungus protoplasm. Before adding the cover slip the mount should be heated gently until vapors are given off.

Spore Stains.—Maneval (1924) suggests the following stain for yeast spores. Spread a film of cells in a drop of water on a slide and dry in air, fix by passing through a flame 12-15 times; stain with hot carbolfuchsin 1-3 minutes; wash with water; destain with 5% sulphuric acid 2-3 seconds; wash with water and stain with methylene blue 3 seconds, wash with water. In 1929, he suggested the following procedure: stain with carbolfuchsin or carbol-methylene blue; destain with 5% acetic acid; treat with 5% tannin for 2 minutes; wash and counterstain with methylene blue (after carbolfuchsin) or with safranin (after carbol-methylene blue). Old spores should be heated in a small amount of sterile water for 10 minutes on a hot water-bath before making the smear. Hufschmitt, Sartory and Meyer (1931) advocate the Moeller method which is slightly different from Maneval's procedure. Treat smear from 10 seconds to 5 minutes in 1% sulphuric acid; wash, stain with carbolfuchsin, heating for 1 minute; differentiate with 5% sulphuric acid for 5 seconds; wash, counterstain with aqueous methylene blue for 3 minutes.

Buschke and Harry (1923) recommend the Schumacher method. Fix, stain for 1 minute in carbol-methylene blue, rinse with distilled water, stain for 1½ minutes, while slowly moving the slide, with 1% phosphin (diamidophenylacridin). Spores also stain with Ziehl-Neelsen acid-fast procedure if the sulphuric acid is replaced by 1% nitric acid alcohol.

Maneval (1929) suggests the following modification of Gutstein's procedure for staining vegetative cells. Fix smear with heat, stain with 5% tannin for 2 minutes, then with safranin or 1% methylene blue, or stain with carbol-methylene blue (5% carbolic acid plus 1% methylene blue) or methylene blue; treat with 5% tannin for 2 minutes, wash, and counterstain with safranin.

It is often very easy to find spores just by making mounts in glycerin and using some dye, such as crystal violet, or lactophenol preparations. Most of the dye preparations will stain vegetative mycelium.

Stains for Fungi in Skin.—Unna, Jr. (1929) advises the following modification of the Pappenheim-Unna, Sr. method for staining fungi in skin. Fix in absolute alcohol, then run through the alcohols to xylol, and embed in paraffin. Cut sections about 10μ thick; stain with pyronine-methyl green (pyronine 9 parts, methyl green 1 part, 96% alcohol 90 parts, glycerol 100 c.c., 0.5% phenol to make 1000 c.c.) for 5-10 seconds; rinse in water; dry with absolute alcohol, and mount in balsam. The fungi will be rubin red, leucocytes green to blue green. (N.B. The cells of the basal horny layer of the epidermis will have red nuclei by this method.)

Fungi in tissue can be stained easily by the usual iron-alum hematoxylin and eosin procedure. The fungus elements take the hematoxylin stain rather nicely, although some difficulty may be encountered in distinguishing spherical cells or spores from tissue elements. The Gram method of staining for bacteria has been used with a measurable amount of success since fungi are, in general, gram-positive.

The formula of Malcolm Morris (Mallory and Wright 1924, p. 175) for staining various parasites of the skin avoids the use of hydrate of potash. The skin is placed in ether or in a mixture of alcohol and ether, equal parts, stained for 5-30 minutes in a solution of 5% gentian violet in 70% alcohol; iodine solution, 1 minute; anilin, or anilin plus 2-4 drops of nitric acid; anilin; xylol; xylol and balsam.

Stains for Fungi in Other Tissues.—A number of methods listed in Mallory and Wright (1924) for staining bacteria in tissue, as well as various types of cells, have been used successfully with fungi. Mallory's anilin blue stain (p. 118) has been used very nicely for *Cryptococcus histolyticus (Torula histolytica)* in brain tissue. The Gram-Weigert staining method (p. 288) is in general use. On p. 414, the authors list two methods for staining *Actinomyces* in sections, although alum-hematoxylin followed by a strong eosin solution will give good results, as will also the Gram method for paraffin sections, which is as follows: Stain in anilin-methyl violet for 5-20 minutes; wash in normal salt solution or water; iodine solution (1:2:300) 1 minute; wash in water; absolute alcohol, several changes, until no more color is given off and the section is apparently decolorized; xylol; xylol and balsam. The so-called "clubs" do not stain with Gram's stain while the central portion of the granule, the thin filaments, do.

Stains for Hair and Scrapings.—Adamson (1895) recommended clearing with 5-10% KOH and staining by the Gram method. Chalmers and Marshall (1914) suggest soaking scales in 40% KOH for some hours in a watch glass in an incubator at 40° C. Transfer specimens to watch glass containing 15% alcohol for 30 minutes, remove to slide, allow alcohol to evaporate, and dry over flame; stain with anilin-gentian violet for 30 minutes. Treat with Gram's iodine solution for 3 minutes; decolorize with anilin oil for 30 minutes; stain in concentrated alcoholic eosin for 1 minute; wash off eosin with anilin oil or clove oil; treat with xylol, and mount in balsam.

Priestley (1917) recommends lactophenol (lactic acid 1 part, phenol 1 part, glycerol 2 parts, water 1 part) for clearing instead of 40% KOH; or chloral hydrate crystals 2 parts, lactic acid 1 part, phenol crystals 1 part, may be used. For staining he recommends treatment with chloroform to remove the fat; boil for 2-3 minutes with formic acid; wash for a few minutes in water, stain with Sahli's methylene blue; wash; differentiate with alcohol, if necessary; dehydrate, and mount in balsam.

Bachman (1920) recommends the following procedure: Place scrapings in a drop of water on a cover slip, tease thoroughly with a dissecting needle, dry over a flame but do not scorch. Stain for 2 minutes; decolorize in 95% alcohol for 15-30 seconds; immerse in distilled water 15-30 seconds; pour off excess, dry by heat, and mount in balsam. The spores and mycelium will be blue, the scrapings yellow. His dye is made as follows: saturated alcoholic gentian violet 2.5 parts, distilled water 17.5 parts, orange G solution 9 parts, acetic acid 1 part, 95% alcohol 5 parts. His orange G solution is orange G 2 parts, 95% alcohol 20 parts, water 80 parts. Decolorize with 10-20% KOH. The host is not stained, the fungus appears yellowish red.

Unna's method is to rub the scales of the epidermis in a little glacial acetic acid between two slides. These are drawn apart and quickly dried over a flame. The fat is removed by means of alcohol and ether, and the preparations are stained in borax-methylene-blue.

Instead of these slightly complicated methods, I have found that infected hairs can be cleared sufficiently to show spores and mycelium by mounting in a hydroxide solution, sodium or potassium, 10-30%. Sodium hydroxide is not quite as satisfactory as potassium hydroxide and a 20% solution works with sufficient rapidity to give good results without seriously macerating the hair. The hair may be immersed in ether to dissolve off oil or fat, and slight heating of the preparation may speed up the reaction. Skin scrapings are also cleared satisfactorily by this simple method. Henrici advocates a 25% solution of antiformin, such as is used in digesting tuberculous sputum, in place of the sodium hydroxide solution.

Stains for Sputum, Pus, etc.—Fungi may be found in sputum, pus, or exudates by making mounts in 20% potassium hydroxide, or by smears. The latter is not very satisfactory except for indicating the presence of mycelium or cells, since smearing tends to disturb the arrangement of the cells. There is usually a great amount of contamination unless one is able to open a fresh lesion which shows no fistulae or draining sinuses. Where the latter are present, biopsies are necessary to find the suspected fungi. Since in exudates the organisms may be few in number, it may require several examinations to locate the parasite. The hydroxide tends to dissolve most of the tissue elements and leave the fungi as refractile bodies.

In potassium hydroxide preparations of scales from inflammatory lesions Becker and Ritchie (1930) have indicated artefacts which rather closely resemble yeast cells. These bodies vary in shape from spherical to ellipsoidal and have a highly refractive wall of varying thickness. Even appearances of sprouting and septal formation occur. These may be removed by treating material progressively with absolute alcohol, ether, absolute and 95% alcohol. The appearances known as mosaic fungus, reported by Greenwood and Rockwood (1930) to be degenerate hyphal cells, is suggested by Becker and Ritchie (1930) to be a result of inflammatory changes in the tissues.

Vital Staining of Fungi.—Dalmau (1929, 1930) reports a technic of vital staining which, while not original with her, deserves much wider use than it receives at present. It is essentially similar to some of the blood stains. The slides should be new, free from blemishes, and should be freed from fat by the use of cleaning solution. After neutralizing, they should be cleaned with a fat-free cloth. Immediately prior to use, all dust must be removed with a new camel's hair brush, washed with ether, and dried. On one slide place one or two drops of Janus green, neutral red or Scharlach R solutions (1:2500) in ethyl alcohol and let them extend over the entire slide, which they will do if the latter is fat-free. Dry in the air. Place a drop of the liquid medium containing the fungus upon a cover slip and invert upon the slide containing the stain. Let settle and then rim the edges with vaseline. Examine at intervals.

Dalmau (1930) reports successful staining of fixed material with the common blood stains (Wright's, Giemsa, and Leishman). With a platinum loop mix some of the colony with a drop of clear blood serum, placed at the end of the slide. Before it dries spread it gently with another slide, thus producing a thin film. Fix with methyl alcohol from 1 to 3 minutes. Stain with the above-mentioned blood stains and use neutral water for washing or diluting the stain. The stain should remain from 5 to 15 minutes. Differentiate for a few seconds only with acetic acid (1:1000). Wash well. The addition of serum prevents undue shrinkage of the cells.

Fixing Agents.—It is at times desirable to kill and fix material to prepare the fungus for staining and clearing. A number of fixatives are used, but most authors recommend either Flemming's weak killing agent which consists of two solutions which are mixed when ready to fix the material (A. 1% chromic acid 25 c.c., 1% acetic acid 10 c.c., water 55 c.c.; B. 1% osmic acid 10 c.c.) or Flemming's strong agent (A. 1% chromic acid 45 c.c., glacial acetic 3 c.c.; B. 2% osmic acid 12 c.c.). Ninety-five per cent alcohol is used, but it is not so suitable for fine work since the material is frequently plasmolyzed. There are various chromo-acetic acid formulae used, but the reader is referred to the standard books on methods in histology for these. One of these formulae, Benda's fluid, has been used favorably with yeastlike fungi. It is a modification of Flemming's strong agent and works well for chromatin investigations. One per cent chromic acid 16 c.c., 2% osmic acid 4 c.c., and glacial acetic acid 2 drops. One of the best, yet most expensive fixing agents I have found for celloidin sections of pathogenic fungi is Hermann's fluid: 1% platinic chloride 15 parts, glacial acetic acid 1 part, 2% osmic acid 2 parts. Fix for 6-12 hours; wash overnight. Merkel's fluid gives good results in organs filled with reserves of food materials.

Paraffin Method.—There are two general methods for embedding material for cutting sections: the paraffin and the celloidin technic. Recently, modifications have been reported, but they have not been sufficiently tested to report here. The paraffin method is familiar to practically all technicians and is in general use, although not very satisfactory for agar cultures. The difficulty seems to lie in the fact that it may cause shrinkage of the material, and it does not penetrate the agar sufficiently for good embedding. Masses of mycelium scraped from the surface of the agar and embedded in paraffin may give favorable results, but it is often desirable to see the characteristics developed in the substrate.

Nitrocellulose Method.—The outstanding method of embedding agar cultures is the second procedure. Although its particular disadvantage lies in the fact that it is difficult to obtain very thin sections as with paraffin and also more difficult to make serial sections, although possible, its advantages surpass those of paraffin. Material if fixed properly will show no shrinkage. The agar substrate is penetrated much better, so that celloidin blocks can be made easily and sections, even if slightly thicker than paraffin sections, clear sufficiently to permit study of the internal structure which is usually broken up or distorted by paraffin.

There are various products of nitrocellulose on the market, e.g., celloidin and collodion. They are sold as shredded or granulated products and are inflammable, but not explosive. Schering's celloidin is in general use. Dupont's parlodion or the product of Mallinckrodt is a purified pyroxylin which gives very good results in embedding and can be obtained as small strips sold in 1-ounce jars. Celloidin may also be obtained in tablet form with directions for making the dilutions accompanying the tablets.

Because of the particular advantages celloidin has over paraffin in making sections of agar cultures for cytologic purposes, I shall list steps that I follow in my work. The general procedure is that improved by Jeffrey (1928) and recently reviewed by Wetmore (1932), but with some slight changes as are better adapted to this type of growth. When the organism is sufficiently developed on a suitable medium, the fixing agent, Hermann's fluid, is poured slowly down the side of the tube. After fixation for from 6-12 hours, depending on the type of organism and growth (a surface growth requiring less time than a deep growth), the fixed culture is washed overnight in slowly running tap water. Care should be taken not to let the water run strongly or the surface mycelium and yeast cells will be washed away. The agar slant is now taken from the test tube, which is broken, and cut up into pieces or blocks approximately 1 sq. cm. or if large tubes are used, approximately 1 cm. by the diameter of the tube. These blocks are next dehydrated in the following alcohols, 2 hours in each: 15%, 25%, 35%, 50%, 70%, 85%, 95%, 100%.

Celloidin may be used warm or cold. For best results it should be used warm. An oven is kept regulated at 45° C. The material is next transferred to a bottle with a collar, containing a solution of ether and absolute alcohol in equal proportions. The bottle is corked and secured by passing a wire around the collar and over the cork as shown by Wetmore. This is placed in the oven and allowed to lie on its side for 24 hours. The preparation is now ready to be run up in celloidin, which has been washed, thoroughly dried, and made up in 2, 4, 6, 8, and 10 per cent solutions in ether-alcohol. Higher percentages may be made, but are not necessary. The material is transferred to each successive dilution every 24 hours, tightly corked, and placed in the 45° C. oven. After the 10% solution, blocks are poured as with paraffin, care being taken not to form bubbles. The blocks are arranged carefully and then set in chloroform to harden for about 12 hours or overnight. When found to be sufficiently hard, the material is placed in 70% alcohol for a few hours to allow for some softening and then it may be stored in glycerol alcohol (95% alcohol indefinitely).

The blocks may be cut with a razor blade to get rid of excess celloidin and to make a uniform block. In order to make sections, the preparations are mounted on small wooden blocks as described by Wetmore. Sections are then cut, as thin as possible, placed in 95% alcohol and then run down to distilled water: 95%, 85%, 70% alcohol, distilled water, 5 minutes in each change, or else run down to the percentage alcohol of the stain used. The sections are now ready to be stained. There are various stains used, but I have found it best to use a 4% mordanting solution of iron-alum (ferric ammonium sulphate) for 10 minutes, washing 4 times with water so that the excess of mordant may be removed. Then 2 drops of Haidenhain's or Ehrlich's hematoxylin are added to a watch glass of sections in water and allowed to stand overnight. The sections are then examined to see whether the material is sufficiently stained. If heavily overstained, they can be decolored with dilute iron alum. They should be slightly overstained, however, because the higher percentage alcohols usually take out some of the dye. The sections are then again dehydrated, but a few drops of chloroform should be added to the absolute alcohol so that the celloidin will not be dissolved. Two changes in absolute alcohol and chloroform and then benzol to clear completely. The sections are then mounted in balsam, making sure that they are completely flattened out. A lead weight is placed on the cover slip and the slide placed in a warm oven for 2 or 3 days. Thus the excess balsam may be pressed out to allow the preparation to be examined with oil immersion.

BIBLIOGRAPHY

Adamson, H. G. 1895. Observations on the parasite of ringworm, *Brit. Jour. Dermatol.* 7: 201-211, 237-244. [*Trans. Internat. Cong. Dermatol.* 3: 555, 1897.]

Amann, Jules. 1896. Conservierungsflussigkeiten und Einschlussmedien für Moose, Chloro- und Cyanophyceen, *Zeitschr. Wiss. Mikr.* 13: 18-21.

Bachmann, Rowland W. 1920. Spore identification in scrapings, *Arch. Derm. Syphilol.* 1: 50-54.

Becker, S. William & Earl B. Ritchie. 1930. The rôle of yeasts in the production of superficial dermatitis, *Arch. Derm. Syphilol.* 22: 790-802.

Bigot, A. 1924. Differents procédés de coloration des cryptocoques pathogènes en médecine vétérinaire, *Bull. Soc. Path. Exot.* 17: 547-551.

Buschke, A. & F. Harry. 1923. Beitrag zur Frage der Sporulations-fähigkeit parasitischer und pathogener Hefen, *Derm. Woch.* 76: 357-360.

Chalmers, Albert J. & Alexander Marshall. 1914. Tinea capitis tropicalis in the Anglo-Egyptian Sudan—the systematic position of the genus Trichophyton Malmsten, 1845, *Jour. Trop. Med. Hyg.* 17: 257-265, 289-291, *3 pls.*

Cornbleet, Theodore. 1930. A reagent for demonstrating fungi in skin scrapings and hair, *Jour. Am. Med. Assn.* 95: 1743, 1744.

Curtis, Otis F. & Reginald H. Colley. 1915. Picro-nigrosin, a combination fixative and stain for algae, *Am. Jour. Bot.* 2: 89-92.

Dalmau, Luz María. 1929, 1930. Observations on mycologic technique with particular reference to pathogenic fungi, *Porto Rico Jour. Public Health and Trop. Med.* 5: 302-311.

Ferrari, Angela. 1930. Un nuovo metodo per la colorazione del micelio, *Atti Ist. Bot. R. Univ. Pavia* IV, 2: 81-87.

Greenwood, A. M. & Ethel M. Rockwood. 1930. The skin in diabetic patients, *Arch. Derm. & Syphilol.* 21: 96-107, *10 figs.*

Henrici, A. T. 1930. Molds, yeasts, and Actinomycetes, New York, John Wiley & Son, 296 pp.

Hufschmitt, G., A. Sartory, R. Sartory & J. Meyer. 1931. Un cas de blastomycose cutanée à foyers multiples, *Ann. Derm. Syphiligr.* 7: 850-876.

Jeffrey, Edward Charles. 1928. Technical contributions, I-V, *Bot. Gaz.* 86: 456-467, *Figs. 1-3.*

Kater, J. McA. 1927. Cytology of Saccharomyces cereviciae with especial reference to nuclear division, *Biol. Bull.* 52: 436-448, *2 pls.*

Kraus, Alfred. 1904. Zur Färbung der Hyphomyceten im Horngewebe, *Zentralbl. Bakt.*, I, 37: 153-156.

Lepik, E. 1928. Differential staining of Peronosporaceae, *Phytopath.* 18: 869-872.

Linder, David Hunt. 1929. An ideal mounting medium for mycologists, *Science* 70: 430.

Mallinckrodt-Haupt, Asta v. 1926. Vitalfärbungen mit Indikatorfarben bei Hyphomyceten, *Derm. Zeitschr.* 46: 263-305.

Mallory, F. B. & J. H. Wright. 1924. Pathological Technique, Philadelphia and London, 666 pp.

Maneval, W. E. 1924. A method of securing spores of yeasts, *Bot. Gaz.* 78: 122, 123.

Pels, Isaac R. & S. Bayne-Jones. 1923. Elastic tissue simulating mycelial filament in skin scrapings, *Arch. Derm. Syphilol.* 8: 37-43.

Priestley, Henry. 1917. Ringworm and allied parasitic skin diseases in Australia, *Med. J. Australia* [4]2: 471-475, *13 figs.*

Sartory, Antoine. 1924. Guide pratique des principales manipulations de mycologie parasitaire à l'usage des pharmaciens, Paris, 341 pp.

Smith, J. Lorrain. 1907. On the simultaneous staining of neutral fat and fatty acid by oxazine dyes, *J. Path. Bact.* 12: 1-4.

Unna, Paul, Jr. 1929. Über Färbung von Fadenpilzen in der Oberhaut, *Derm. Woch.* 88: 314-321.

Unna, Paul. 1891. Die Färbung der Mikroorganismen im Horngewebe, *Monatsch. Derm.* 13: 225-237, 286-311.

Weston, William H. 1929. A useful modification of Amann's medium, *Science* 70: 455.

Wetmore, Ralph H. 1932. The use of celloidin in botanical technique, *Stain Techn.* 7: 37-62, *6 figs.*

CHAPTER VI

BOTANICAL NOMENCLATURE

The problem of selecting a name for an organism is a very ancient one. Early plant names were simple nouns in the language in use by various botanists. As likenesses and differences were more clearly realized, adjectives were applied to distinguish between closely related groups. In the course of centuries these adjectives became attached to nouns in a definite and usually stable manner. During the period from the introduction of printing to the middle of the eighteenth century, the noun gradually took on the generic concept, and the group of adjectives, the specific concept. As this usage became more prevalent, a binomial nomenclature was approached, until Linnaeus in his *Species Plantarum* of 1753 used it almost universally.

The last half of the eighteenth century was predominantly one of exploration and description of many new plants and animals. The same organism was often named more than once by workers in ignorance of the publications of others. Then the problem of which name to choose became increasingly urgent. In general, the principle of priority developed, by which the oldest binomial name for a group was chosen. During the nineteenth century, these problems became increasingly difficult, and authors developed codes of rules for their own use. As a result of this, by the close of the nineteenth century varying practice for handling the same situation had grown up in various countries. In America we had two more or less divergent systems which caused much confusion, as one set of workers used one set of names for their plants while another group used different names for the same plants.

An attempt to reach a compromise was made in the last decade of the century, but this was ineffective. At the International Congress at Paris in 1900, a committee was appointed to draft a code and report to the Congress at Vienna in 1905. This code, adopted after much discussion, forms the basis for our present code. It was extensively amended at Brussels in 1910 and at Cambridge (England) in 1930.

The official edition of the Code with the 1930 amendments has not yet been published. The most active member of the editorial committee died shortly after the Congress. I have been unable to secure from the surviving member, information as to the probable time of publication.

As this book goes to press, A. B. Rendle, Jour. Bot. Brit. For. 72: Supplement 1-29, June, 1934) has published his version of the Code with the approval of the surviving member of the editorial committee, so that it is probable that Rendle's version will not differ materially from the official version. In general, Rendle's version has been reproduced in the following pages, but I have corrected obvious *lapsi calami* and added examples of the application of the rules based on names of fungi familiar to medical men which illustrate the point as well as the examples given by Rendle. In this book, I have endeavored to follow the spirit of the International Rules, although it has been impossible to apply the letter of the law in some instances.

INTERNATIONAL RULES OF BOTANICAL NOMENCLATURE*

Chapter I.—General Considerations and Guiding Principles

Art. 1. Botany cannot make satisfactory progress without a precise system of nomenclature, which is used by the great majority of botanists in all countries.

Art. 2. The precepts on which this precise system of botanical nomenclature is based are divided into *principles, rules,* and *recommendations.* The principles (Art. 1-9, 10-14, 15-19†) form the basis of the rules and recommendations. The object of the rules (Art. 19-74) is to put the nomenclature of the past into order and to provide for that of the future. They are always retroactive: names or forms of nomenclature contrary to a rule (illegitimate names or forms) cannot be maintained. The recommendations deal with subsidiary points, their object being to bring about greater uniformity and clearness in future nomenclature: names or forms contrary to a recommendation cannot on that account be rejected, but they are not examples to be followed.

Art. 3. The rules of nomenclature should be simple and founded on considerations sufficiently clear and forcible for everyone to comprehend and be disposed to accept.

Art. 4. The essential points in nomenclature are: (1) to aim at fixity of names; (2) to avoid or to reject the use of forms and names which may cause error or ambiguity or throw science into confusion.

Next in importance is the avoidance of all useless creation of names.

Other considerations, such as absolute grammatical correctness, regularity or euphony of names, more or less prevailing custom, regard for persons, etc., notwithstanding their undeniable importance, are relatively accessory.

Art. 5. In the absence of a relevant rule, or where the consequences of rules are doubtful, established custom must be followed.

Art. 6. Botanical nomenclature is independent of zoological nomenclature in the sense that the name of a plant is not to be rejected simply because it is identical with the name of an animal. If, however, an organism is transferred from the animal to the plant kingdom, its validly published names are to be accepted as botanical nomenclature in the form prescribed by the rules of botanical nomenclature; and if an organism is transferred from the plant to the animal kingdom its names retain their status in botanical nomenclature.

Art. 7. Scientific names of all groups are usually taken from Latin or Greek. When taken from any language other than Latin, or formed

---

*This entire section set in narrow measure is reprinted from *International Rules of Botanical Nomenclature* adopted by the Fifth International Botanical Congress, Cambridge, 1930. Supplement to *The Journal of Botany,* June, 1934. Printed and published by Taylor and Francis.

† Art. 19 is both a principle and a rule.

in an arbitrary manner, they are treated as if they were Latin. Latin terminations should be used so far as possible for new names.

Art. 8. Nomenclature deals with: (1) the *terms* which denote the rank of taxonomic groups (Art. 10-14); (2) the *names* which are applied to the individual groups (Art. 15-72).

Art. 9. The rules and recommendations of botanical nomenclature apply to all groups of the plant kingdom, recent and fossil, with certain distinctly specified exceptions.

Chapter II.—CATEGORIES OF TAXONOMIC GROUPS, AND THE TERMS DENOTING THEM (Art. 10-14, Rec. I, II).

Art. 10. Every individual plant, interspecific hybrids and chimæras excepted, belongs to a species (*species*), every species to a genus (*genus*), every genus to a family (*familia*), every family to an order (*ordo*), every order to a class (*classis*), every class to a division (*divisio*).

Art. 11. In many species varieties (*varietas*), forms (*forma*), and races or biological forms (*forma biologica*) are distinguished; in parasitic species special forms (*forma specialis*), and in certain cultivated species modifications still more numerous; in many genera sections (*sectio*) are distinguished, in many families tribes (*tribus*).

Recommendation I. In parasites, especially parasitic fungi, authors who do not give specific value to forms characterized from a biological standpoint, but scarcely or not at all from a morphological standpoint, should distinguish within the species special forms (*forma specialis*) characterized by their adaption to different hosts.

Art. 12. Finally, if a greater number of intermediate categories are required, the terms for these subdivisions are made by adding the prefix sub (*sub*) to the terms denoting the categories. Thus subfamily (*subfamilia*) denotes a category between a family and tribe, subtribe (*subtribus*) a category between a tribe and a genus, etc. The classification of subordinated categories may thus be carried, for wild plants, to twenty-three degrees in the following order: Regnum vegetabile. Divisio. Subdivisio. Classis. Subclassis. Ordo. Subordo. Familia. Subfamilia. Tribus. Subtribus. Genus. Subgenus. Sectio. Subsectio. Species. Subspecies. Varietas. Subvarietas. Forma. Forma biologica. Forma specialis. Individuum.

If this list of categories is insufficient it can be augmented by the intercalation of supplementary categories, provided that this does not introduce confusion or error: e. g., *series* and *subseries* are categories which can be intercalated between subsection and species.

Recommendation II. The arrangement of species in a genus or in a subdivision of a genus is made by means of typographic signs, letters or numerals.

Art. 13. The definition of each of these categories varies, up to a certain point, according to individual opinion and the state of the science; but their relative order, sanctioned by custom, must not be altered. No classification is admissible which contains such alterations: e. g., a form divided into varieties, a species containing genera.

Art. 14. The fertilization of one species by another may give rise to a hybrid (*hybrida*); that of a modification or subdivision of a species by another modification of the same species may give rise to a halfbreed (*mistus*).

Chapter III.—Names of Taxonomic Groups (Art. 15-72, Rec. III—L).

Section 1.—**General Principles: priority** (Art. 15-17, Rec. III).

Art. 15. The purpose of giving a name to a taxonomic group is not to indicate the characters or the history of the group, but to supply a means of referring to it.

Art. 16. Each group with a given circumscription, position, and rank can bear only one valid name,* the earliest that is in accordance with the Rules of Nomenclature.

Art. 17. No one may change a name (or combination of names) without serious motives, based either on more profound knowledge of facts or on the necessity of giving up a nomenclature that is contrary to the Rules.

Recommendation III. Changes in nomenclature should be made only after adequate taxonomic study.

Section 2.—**The Type Method** (Art. 18, Rec. IV-VII).

Art. 18. The application of names of taxonomic groups is determined by means of *nomenclatural types*. A nomenclatural type is that constituent element of a group to which the name of the group is permanently attached, whether as an accepted name or as a synonym. The name of a group must be changed if the type of that name is excluded (see Art. 66).

The type of the name of an order or suborder is a family, that of the name of a family, subfamily, tribe or subtribe is a genus, that of a generic name is a species, that of the name of a species or group of lower rank is usually a specimen or preparation. In some species, however, the type is a description or figure given by a previous author. Where permanent preservation of a specimen or preparation is impossible, the application of the name of a species or subdivision of a species is determined by means of the original description or figure.

Note.—The nomenclatural type is not necessarily the most typical or representative element of a group; it is merely that element with which the name of the group is permanently associated.

Recommendations:

IV. When publishing names of new groups authors should indicate carefully the subdivision which is the type of the new name: the type-genus in a family, the type-species in a genus, the type-variety or specimen in a species. This type determines the application of the name in the event of the group being subsequently divided. When describing new species, varieties or forms of parasitic plants, especially Fungi, the host plant of the type should be indicated.

V. When revising a genus an author should state which species he accepts as the nomenclatural type.

VI. In selecting a nomenclatural type for a genus of non-vascular Cryptogams, botanists should, where possible, choose a species that will fix the generic name as it is now commonly applied.

---

*In genera and groups of higher rank the valid name is the earliest name published with the same rank, provided that this is in conformity with the Rules of Nomenclature and the provisions of Arts. 20 and 21.

In subdivisions of genera the valid name is the earliest name published with the same rank, provided that this name and its combination with the generic name are in conformity with the Rules of Nomenclature.

In species and groups of lower rank the valid name is the binary or ternary combination containing the earliest epithet published with the same rank, provided that this combination is in conformity with the Rules of Nomenclature.

VII. The utmost importance should be given to the preservation of the orginal ("type") material on which the description of a new group is based. In microscopic Cryptogams the preparations and original drawings, in fleshy Fungi watercolour drawings and specimens suitably prepared or dried, should be preserved. The original account should state where this material is to be found.

Section 3.—**Limitation of the Principle of Priority: publication, starting-points, conservation of names** (Art. 19-22).

Art. 19. A name of a taxonomic group has no status under the Rules, and has no claim to recognition by botanists, unless it is validly published (see Section 6, Art. 37).

Art. 20. Legitimate botanical nomenclature begins for the different groups of plants at the following dates:—

(*a*) Phanerogamae and Pteridophyta, 1753 (Linnæus, *Species Plantarum,* ed. 1).

(*b*) Muscineae, 1801 (Hedwig, *Species Muscorum*).

(*c*) Sphagnaceae and Hepaticae, 1753 (Linnæus, *Species Plantarum,* ed. 1).

(*d*) Lichenes, 1753 (Linnæus, *Species Plantarum,* ed. 1).

(*e*) Fungi: Uredinales, Ustilaginales and Gasteromycetes, 1801 (Persoon, *Synopsis methodica Fungorum*).

(*f*) Fungi cæteri, 1821-32 (Fries, *Systema mycologicum*).

(*g*) Algae, 1753 (Linnæus, *Species Plantarum,* ed. 1).

Exceptions.—Nostocaceae homocysteae, 1892-93 (Gomont, *Monographie des Oscillariées* in *Ann. Sci. Nat.* sér. 7, Bot. vi. 91; vii, 263).—Nostocaceae heterocysteae, 1886-88 (Bornet et Flahault, *Revision des Nostocacées hétérocystées* in *Ann. Sci. Nat.* sér. 7, Bot. iii, 323; iv, 344; v, 51; vii, 177).—Desmidiaceae, 1858 (Ralfs, *British Desmidiaceae*).—Oedogoniaceae, 1900 (Hirn, *Monographie und Iconographie der Oedogoniaceen* in *Act. Soc. Sci. Fenn.* xxvii, No. 1).

(*h*) Myxomycetes, 1753 (Linnæus, *Species Plantarum,* ed. 1).

The nomenclature of Fossil Plants of all groups begins with the year 1820.

It is agreed to associate generic names which appear in Linnæus's *Species Plantarum,* ed. 1 (1753) and ed. 2 (1762-63), with the first subsequent descriptions given under those names in Linnæus's *Genera Plantarum,* ed. 5 (1754) and ed. 6 (1764).

Art. 21. However, to avoid disadvantageous changes in the nomenclature of genera by the strict application of the Rules of Nomenclature, and especially of the principle of priority in starting from the dates given in Art. 20, the Rules provide a list of names which must be retained as exceptions. These names are by preference those which have come into general use in the fifty years following their publication, or which have been used in monographs and important floristic works up to the year 1890.

Note 1.—These lists of conserved names will remain permanently open for additions. Any proposal of an additional name must be accompanied by a detailed statement of the cases for and against its conservation. Such proposals must be submitted to the Executive Committee, who will refer them for examination to the Special Committees for the various taxonomic groups.

Note 2.—The application of conserved names is determined by nomenclatural types, or by substitute-types where necessary or desirable.

Note 3.—A conserved name is conserved against all other names for the group, whether these are cited in the corresponding list of rejected names or not, so long as the group concerned is not united or reunited with another group bearing a legitimate name. In the event of union or reunion with another group, the earlier of the two competing names is adopted in accordance with Art. 56.

Note 4.—A conserved name is conserved against all earlier homonyms.

Art. 22. When a name proposed for conservation has been provisionally approved by the Executive Committee, botanists are authorized to retain it pending the decision of the next International Botanical Congress.

Section 4.—**Nomenclature of the Taxonomic Groups according to their Categories** (Art. 23-35, Rec. VIII-XX).

§ 1. *Names of Groups above the Rank of Family.*

Recommendations:

VIII. Names of divisions and subdivisions, of classes and subclasses, are taken from their chief characters. They are expressed by words of Greek or Latin origin in the plural number, some similarity of form and termination being given to those which designate groups of the same nature.

IX. Orders are designated preferably by the name of one of their principal families, with the ending *-ales*. Suborders are designated in a similar manner, with the ending *-ineae*. But other terminations may be used for these names, provided that they do not lead to confusion or error.

§ 2. *Names of Families and Subfamilies, Tribes, and Subtribes.*

Art. 23. Names of families are taken from the name or former name of one of their genera and end in *-aceae.*

Exceptions:

(1) The following names, sanctioned by long usage, are treated as exceptions to the rule: *Palmae, Gramineae, Cruciferae, Leguminosae, Guttiferae, Umbelliferae, Labiatae, Compositae.* Botanists are authorized, however, to use as alternatives the appropriate names ending in *-aceae.*

(2) Those who regard the *Papilionaceae* as constituting an independent family may use that name, although it is not formed in the prescribed manner.

Note.—To avoid disadvantageous changes in the nomenclature of families by the strict application of the Rules, and especially of the principle of priority, a list of names which must be retained as exceptions will be provided (Appendix II).

Art. 24. Names of subfamilies (*subfamiliae*) are taken from the name of one of the genera in the group, with the ending *-oideae,* similarly for tribes (*tribus*), with the ending *-eae,* and for subtribes (*subtribus*), with the ending *-inae.*

§ 3. *Names of Genera and Subdivisions of Genera.*

Art. 25. Names of genera are substantives (or adjectives used as substantives), in the singular number and written with an initial capital, which may be compared with our family names. These names may be taken from any source whatever, and may even be composed in an absolutely arbitrary manner.

Recommendation X. Botanists who are forming generic names show judgment and taste by attending to the following recommendations:—

(*a*) Not to make names long or difficult to pronounce.

(*b*) Not to dedicate genera to persons quite unconnected with botany, or at least with natural science, nor to persons quite unknown.

(*c*) Not to take names from barbarous languages, unless those names are frequently cited in books of travel, and have an agreeable form that is readily adaptable to the Latin tongue and to the tongues of civilized countries.

(*d*) To indicate, if possible, by the formation or ending of the name the affinities or analogies of the genus.

(*e*) To avoid adjectives used as nouns.

(*f*) Not to give a genus a name whose form is rather that of a subgenus or section (e. g. *Eutorula,* a name given to a genus of *Saccharomycetaceae Imperfectae.* This, however, being legitimate, cannot be altered).

(*g*) Not to make names by combining words from different languages (*nomina hybrida*).

Art. 26. Names of subgenera and sections are usually substantives resembling the names of genera: e. g. *Fraxinaster, Archieracium.* Names of subsections and other lower subdivisions of genera are preferably adjectives in the pleural number agreeing in gender with the generic name and written with an initial capital, or their place may be taken by an ordinal number or a letter: e. g. *Pleiostylae, Fimbriati, Bibracteolata.*

Recommendations:

XI. Botanists constructing names for subgenera or sections will do well to attend to the preceding recommendations and also to the following:—

(*a*) To give, where possible, to the principal division of a genus a name which recalls that of the genus with some modification or addition. Thus *Eu* may be placed at the beginning of the generic name when it is of Greek origin, *-astrum*, *-ella* at the end of the name when Latin, or any other modification consistent with the grammar and usages of the Latin language: e. g. *Eucardamine* (from *Cardamine*), *Drabella* (from *Draba*).

(*b*) To avoid giving to a subgenus or a section the name of the genus to which it belongs, with the ending *-oides* or *-opsis:* but on the contrary to reserve this ending for a section which resembles another genus and by then adding *-oides* or *-opsis* to the name of that other genus, if it is of Greek origin, to form the name of the section.

(*c*) To avoid taking as the name of a subgenus or section a name which is already in use as such in another genus, or which is the name of a genus.

(*d*) To avoid in co-ordinated subdivisions of a genus the use of names in the form of a noun together with those in the form of a plural adjective; the former should be used chiefly for subgenera and sections, the latter for subsections, series and subseries.

XII. When it is desired to indicate the name of a subgenus or section (or other subdivision to which a particular species belongs) in connection with the generic name and specific epithet, the name of the subdivision is placed in parentheses between the two (where necessary, the rank of the subdivision is also indicated): e. g. *Achorion* (Sect. *Lophophyton*) *muris.*

§ 4. *Names of Species (binary names).*

Art. 27. Names of species are binary combinations consisting of the name of the genus followed by a single specific epithet. If an epithet consists of two or more words, these must either be united into one or joined by a hyphen. Symbols forming part of specific epithets proposed by Linnæus must be transcribed.

The specific epithet, when adjectival in form and not used as a substantive, agrees with the generic name.

Recommendations:

XIII. The specific epithet should, in general, give some indication of the appearance, the characters, the origin, the history or the properties of the species. If taken from the name of a person it usually recalls the name of the one who discovered or described it, or was in some way concerned with it.

XIV. Names of men and women, and also of countries and localities used as specific epithets, may be substantives in the genitive (*Truchisi*) or adjectives (*Valeriana, lipsiense*). It will be well, in the future, to avoid the use of the genitive and the adjectival form of the same epithet to designate two different species of the same genus.

XV. In forming specific epithets botanists will do well to have regard also to the following recommendations:—

(*a*) To avoid those which are very long and difficult to pronounce.
(*b*) To avoid those which express a character common to all, or nearly all, the species of a genus.
(*c*) To avoid using the names of little-known or very restricted localities, unless the species is quite local.
(*d*) To avoid, in the same genus, epithets which are very much alike, especially those which differ only in their last letters.
(*e*) Not to adopt unpublished names found in travellers' notes or in herbaria, attributing them to their authors, unless these have approved publication.
(*f*) Not to name a species after a person who has neither discovered, nor described, nor figured, nor in any way studied it.
(*g*) To avoid epithets which have been used before in any closely allied genus.
(*h*) To avoid specific epithets formed of two or more (hyphened) words.
(*i*) To avoid epithets which have the same meaning as the generic name (pleonasm).

§ 5. *Names of Groups below the rank of Species (ternary names).*

Art. 28. Epithets of subspecies and varieties are formed like those of species and follow them in order, beginning with those of the highest rank. When adjectival in form and not used as substantives they agree with the generic name. Similarly for subvarieties, forms and slight or transient modifications of wild plants, which receive either epithets, or numbers, or letters to facilitate their arrangement. The use of a binary nomenclature for subdivisions of species is not admissible. It is permissible to reduce more complicated names to ternary combinations.

Art. 29. The same epithet may be used for subdivisions of different species, and the subdivisions of one species may bear the same epithet as other species: e. g. *Rosa Jundzillii* var. *leioclada* and *Rosa glutinosa* var. *leioclada, Viola tricolor* var. *hirta* in spite of the existence already of a different species named *Viola hirta.*

Art. 30. Two subdivisions of the same species, even if they are of different rank, cannot bear the same subdivisional epithet, unless they are based on the same type. If the earlier subdivisional name (ternary combination) was validly published, the later one is illegitimate, and must be rejected.

The ternary combinations *Biscutella didyma* subsp. *apula* Briq. and *Biscutella didyma* var. *apula* Halácsy may both be used because they are based on the same type, and the one includes the other.

The following is incorrect: *Erysimum hieracifolium* subsp. *strictum* var. *longisiliquum* and *E. hieracifolium* subsp. *pannonicum* var. *longisiliquum*—a form of nomenclature which allows two varieties bearing the same name in the same species.

Recommendations:

XVI. Recommendations made for specific epithets apply equally to epithets of subdivisions of species.

XVII. Special forms (*forma specialis*) are preferably named after the host species; if desired, double names may be used: e. g. *Puccinia Hieracii* f. sp. *villosi, Pucciniastrum Epilobii* f. sp. *Abieti-Chamaenerii.*

XVIII. Botanists should avoid giving a new epithet to any subdivision of a species which includes the type either of the specific name or of a higher subdivisional name. They should either repeat that epithet or use one of the customary epithets, *typicus, genuinus, originarius,* etc. E. g. *Andropogon caricosus* subsp. *mollissimus* var. *mollissimus* Hackel; *Arthraxon ciliaris* Beauv. subsp. *Langsdorfii* var. *genuinus* Hackel.

XIX. Botanists proposing new epithets for subdivisions of species should avoid such as have been used previously in the same genus, whether for species or for subdivisions of other species.

§ 6. *Names of Hybrids and Half-breeds.*

Art. 31. Hybrids or putative hybrids between species of the same genus are designated by a formula and, whenever it seems useful or necessary, by a name.

(1) *Sexual hybrids.*—The formula consists of the names or specific epithets of the two parents in alphabetical order and connected by the sign ×. When the hybrid is of known experimental origin the formula may be made more precise by the addition of the signs ♀ ♂, the name of the female (seed-bearing) parent being placed first.

The name, which is subject to the same rules as names of species, is distinguished from the latter by the sign × before the name: e. g. × *Salix capreola* (*Salix aurita* × *caprea*).

(2) *Asexual hybrids* (graft hybrids, chimæras, etc.).—The formula consists of the names of the two parents in alphabetical order connected by the sign +. The name has a "specific" epithet different from that of the corresponding sexual hybrid (if any), and is preceded by the sign +: e. g. + *Solanum tubingense* (*Solanum nigrum* + *S. Lycopersicum*).

Art. 32. Bigeneric hybrids (hybrids between species of two genera) are also designated by a formula and, whenever it seems useful or necessary, by a name.

The formula consists of the names of the two parents connected by a sign, as in Art. 31.

The name consists of a new "generic" name usually formed by a combination of the names of the parent genera, and a "specific" epithet. All hybrids (whether sexual or asexual) between the same two genera bear the same "generic" name.

(1) *Sexual hybrids.*—In the formula the connecting sign × is used. The name is preceded by the sign ×: e. g. × *Odontioda Boltonii* (*Cochlioda Noezliana* × *Odontoglossum Vuylstekeae*).

(2) *Asexual hybrids.*—In the formula the connecting sign + is used. The name is preceded by the sign +. The "specific" epithet is different from that of the corresponding sexual hybrid (if any) between the same species. E. g. + *Laburnocytisus Adami* (*Laburnum anagyroides* +*Cytisus purpureus*).

Art. 33. Ternary hybrids, or those of a higher order, are designated, like ordinary hybrids, by a formula and, whenever it seems useful or necessary, by a name. Such as are trigeneric or polygeneric are given new "generic" names usually formed by a combination of the names of the parent genera.

Recommendation XX. Half-breeds, or putative half-breeds, may be designated by a name and a formula. Names of half-breeds are intercalated among the subdivisions of a species, and are preceded by the sign ×. In the formula the names of the parents are in alphabetical order. When the half-breed is of known experimental origin the formula may be made more precise by the addition of the signs ♀ ♂, the name of the female (seed-bearing) parent being placed first.

Art. 34. When different hybrid forms of the same parentage (pleomorphic hybrids; combinations between different forms of a collective species, etc.) are united in a collective group, the subdivisions are classed under the binary name of the hybrid, like the subdivisions of a species under that of a species.

Examples: × *Mentha niliaca β Lamarckii* (= *M. longifolia* × *rotundifolia*). The preponderance of the characters of one or other parent may be indicated in the formulæ in the following manner: *Mentha longifolia* > × *rotundifolia*, *M. longifolia* × < *rotundifolia*. The participation of a particular variety may also be indicated: e. g. *Salix caprea* × *daphnoides* var. *pulchra*.

§ 7. *Names of Plants of Horticultural Origin.*

Art. 35. Forms and half-breeds among cultivated plants receive fancy epithets, preferably in common language, as different as possible from the Latin epithets of species or varieties. When they can be attached to a species, a subspecies or a botanical variety this is indicated by a succession of names: e. g. *Pelargonium zonale* Mrs. Pollock.

Section 5.—**Conditions of effective Publication.**

Art. 36. Publication is effected, under these Rules, either by sale or distribution of printed matter or indelible autographs to the general public, or to specified representative botanical institutions*.

No other kind of publication is accepted as effective: communication of new names at a public meeting, or the placing of names in collections or gardens open to the public, does not constitute effective publication.

Section 6.—**Conditions and Dates of valid Publication of Names** (Art. 37–45, Rec. XXI–XXIX).

Art. 37. A name of a taxonomic group is not validly published unless it is both (1) effectively published (see Art. 36), and (2) accompanied by a description of the group or by a reference to a previously and effectively published description of it.

Mention of a name on a ticket issued with a dried plant without a printed or autographed description does not constitute valid publication of that name.

Note.—In certain circumstances a plate or figure with analyses is accepted as equivalent to a description (*vide* Art. 43, 44).

Art. 38. From January 1, 1935, names of new groups of recent plants, the Bacteria excepted, are considered as validly published only when they are accompanied by a Latin diagnosis.

Art. 39. From January 1, 1912, the name of a new taxonomic group of fossil plants is not considered as validly published unless it is accompanied by illustrations or figures showing the essential characters, in addition to the description.

Art. 40. A name of a taxonomic group is not validly published when it is merely cited as a synonym.

Art. 41. A group is not characterized, and the publication of its name is not validated, merely by mention of the subordinate groups included in it: thus the publication of the name of the order is not validated by mention of the included families; that of a family is not validated by mention of the included genera; that of a genus is not validated by mention of the included species. E. g. the generic name *Ibidium* Salisbury (Trans. Hort. Soc. i, 291: 1812) was published merely with the mention of four included species: as Salisbury supplied no generic description, the publication of *Ibidium* was invalid.

---

*The preparation of a list of representative botanical institutions is referred to the Executive Committee (see App. VII).

Art. 42. A name of a genus is not validly published unless it is accompanied (1) by a description of the genus, or (2) by the citation of a previously and effectively published description of the genus under another name, or (3) by a reference to a previously and effectively published description of the genus as a subgenus, section or other subdivision of a genus.

An exception is made for the generic names published by Linnæus in *Species Plantarum*, ed. 1 (1753) and ed. 2 (1762–63), which are treated as having been validly published on those dates (see Art. 20).

Note.—In certain circumstances a plate with analyses is accepted as equivalent to a generic description (see Art. 43).

Art. 43. The name of a monotypic new genus based on a new species is validated (1) by the provision of a combined generic and specific description (*descriptio generico-specifica*), (2) by the provision of a plate with analyses showing essential characters; but this applies only to plates and generic names published before January 1, 1908.

Art. 44. The name of a species or of a subdivision of a species is not validly published unless it is accompanied (1) by a description of the group, or (2) by the citation of a previously and effectively published description of the group under another name, or (3) by a plate or figure with analyses showing essential characters; but this applies only to plates or figures published before January 1, 1908.

Art. 45. The date of a name or of an epithet is that of its valid publication (see Art. 19, 36). For purposes of priority, however, only legitimate names and epithets published in legitimate combinations are taken into consideration* (see Art. 60). In the absence of proof to the contrary, the date given in the work containing the name or epithet must be regarded as correct.

On and after January 1, 1935, only the date of publication of the Latin diagnosis can be taken into account for recent plants except Bacteria.

For fossil plants, on and after January 1, 1912, the date is that of the simultaneous publication of the description and figure (or, if these are published at different dates, the later of the two dates).

Botanists will do well in publishing to conform to the following recommendations:—

XXI. Not to publish a new name without clearly indicating whether it is the name of a family or a tribe, a genus or a section, a species or a variety; briefly, without expressing an opinion as to the rank of the group to which the name is given.

Not to publish the name of a new group without indicating its type (see Recommendation IV).

XXII. To avoid publishing or mentioning in their publications unpublished names which they do not accept, especially if the persons responsible for these names have not formally authorized their publication (see Recommendation XV [*e*]).

---

*A legitimate name or epithet is one that is strictly in accordance with the Rules.

XXIII. When publishing names of new groups of plants in works written in a modern language (floras, catalogues, etc.), to publish simultaneously the Latin diagnoses of recent plants (Bacteria excepted) and the figures of fossil plants, which will make these names valid according to the Rules.

XXIV. In describing new groups of lower Cryptogams, especially among the Fungi, or among microscopic plants, to add to the description a figure or figures of the plants, with details of microscopic structure, as an aid to identification.

XXV. The description of parasitic plants should always be followed by the indication of the hosts, especially in the case of parasitic fungi. The hosts should be designated by their Latin scientific names and not by popular names in modern languages, the significance of which is often doubtful.

XXVI. To give the etymology of new generic names and also of new epithets when the meaning of these is not obvious.

XXVII. To indicate precisely the date of publication of their works and that of the placing on sale or the distribution of named and numbered plants when these are accompanied by printed diagnoses. In the case of a work appearing in parts, the last published sheet of the volume should indicate the precise dates at which the different fascicles or parts of the volumes were published as well as the number of pages in each.

XXVIII. When works are published in periodicals, to require the publisher to indicate on the separate copies the date (year and month) of publication and also the title of the periodical from which the work is extracted.

XXIX. Separate copies should always bear the pagination of the periodical of which they form a part; if desired they may also bear a special pagination.

Section 7.—**Citation of Authors' Names for purposes of precision** (Art. 46–49, Rec. XXX–XXXII).

Art. 46. For the indication of the name (unitary, binary, or ternary) of a group to be accurate and complete, and in order that the date may be readily verified, it is necessary to cite the author who first published the name in question.

Art. 47. An alteration of the diagnostic characters or of the circumscription of a group does not warrant the citation of an author other than the one who first published its name.

When the changes have been considerable, an indication of their nature and of the author responsible for the change is added, the words *mutatis charact.*, or *pro parte*, or *excl. gen.*, *excl. sp.*, *excl. var.*, or some other abridged indication being employed.

Examples: *Phyllanthus* L. em. (emendavit) Müll. Arg.; *Myosotis* L. pro parte, R. Br.; *Globularia cordifolia* L. excl. var. (em. Lam.).

Art. 48. When a name of a taxonomic group has been proposed but not published by one author, and is subsequently validly published and ascribed to him (or her) by another author who supplied the description, the name of the latter author must be appended to the citation with the connecting word "ex." The same holds for names of garden origin cited as "Hort." E. g. *Capparis lasiantha* R. Br. ex DC.; *Gesneria Donklarii* Hort. ex Hook.

If it is desirable or necessary to abbreviate such a citation, the name of the publishing author, being the more important, must be retained.

Where a name and description by one author are published by another author, the word *apud* is used to connect the names of the two authors, except where the name of the second author forms part of the title of a book or periodical in which case the connecting word *in* is used instead.

Art. 49. When a genus or a group of lower rank is altered in rank but retains its name or epithet, the original author must be cited in parentheses, followed by the name of the author who effected the alteration. The same holds when a subdivision of a genus, a species, or a group of lower rank is transferred to another genus or species with or without alteration of rank.

Examples: *Medicago polymorpha* L. var. *orbicularis* L., when raised to the rank of a species, becomes *Medicago orbicularis* (L.) All. *Sorbus* sect. *Aria* Pers., on transference to *Pyrus*, is cited as *Pyrus* sect. *Aria* (Pers.) DC.

Recommendations:

XXX. Authors' names put after names of plants are abbreviated, unless they are very short.

For this purpose preliminary particles or letters that, strictly speaking, do not form part of the name are suppressed, and the first letters are given without any omission. If a name of one syllable is long enough to make it worth while to abridge it, the first consonants only are given (Br. for Brown); if the name has two or more syllables, the first syllable and the first letter of the following one are taken, or the two first when both are consonants (Juss. for Jussieu, Rich. for Richard). When it is necessary to give more of a name to avoid confusion between names beginning with the same syllables, the same system is to be followed. For instance, two syllables are given together with the one or two first consonants of the third; or one of the last characteristic consonants of the name is added (Bertol. for Bertoloni, to distinguish from Bertero; Michx. for Michaux, to distinguish from Micheli). Christian names or accessory designations, serving to distinguish two botanists of the same name, are abridged in the same way (Adr. Juss. for Adrien de Jussieu, Gaertn. fil. or Gaertn. f. for Gaertner filius).

When it is a well-established custom to abridge a name in another manner it is best to conform to it (L. for Linnæus, DC. for De Candolle, St. Hil. for Saint-Hilaire).

In publications destined for the general public and in titles it is preferable not to abridge.

XXXI. When citing a name published as a synonym, the words "as synonym," or *pro synon.* should be added to the citation. When an author published as a synonym a manuscript name of another author, the word *ex* should be used to connect the names of the two authors: e. g. *Myrtus serratus* Koenig ex Steud. *Nomencl.* 321 (1821), pro synon., a manuscript name of Koenig's published by Steudel as a synonym of *Eugenia laurina* Willd.

XXXII. The citation of authors earlier than the starting point of the nomenclature of a group is indicated, when considered useful or desirable, preferably between brackets or by the use of the word *ex*. This method is especially applicable in mycology when reference is made to authors earlier than Fries or Persoon.

Section 8.—**Retention of Names or Epithets of Groups which are remodelled or divided** (Art. 50–52).

Art. 50. An alteration of the diagnostic characters, or of the circumscription of a group, does not warrant a change in its name, except so far as this may be necessitated (1) by transference of the group (Art. 53–55), or (2) by its union with another group of the same rank (Art. 56–57), or (3) by a change of its rank (Art. 58).

Examples: The genus *Myosotis* as revised by R. Brown differs from the original genus of Linnæus, but the generic name has not been changed, nor is a change allowable.—Various authors have united with *Centaurea Jacea* L. one or two species which Linnæus had kept distinct; the group thus constituted must be called *Centaurea Jacea* L. sensu ampl. or *Centaurea Jacea* L. em. Visiani, or em. Godron, etc.: the creation of a new name such as *Centaurea vulgaris* Godr. is superfluous.

Art. 51. When a genus is divided into two or more genera, the generic name must be retained for one of them, or (if it has not been retained) must be re-established. When a particular species was originally designated as the type, the generic name must be retained for the genus including that species. When no type was designated, a type must be chosen according to the regulations which will be given (Appendix I).

Art. 52. When a species is divided into two or more species, the specific epithet must be retained for one of them, or (if it has not been retained) must be re-established. When a particular specimen was originally designated as the type, the specific epithet must be retained for the species including that specimen. When no type was designated, a type must be chosen according to the regulations to be given (Appendix I).

The same rule applies to subdivisions of species; for example, to a subspecies divided into two or more subspecies, or to a variety divided into two or more varieties.

Section 9.—**Retention of Names or Epithets of Groups below the Rank of Genus on transference to another Genus or Species** (Art. 53–55).

Art. 53. When a subdivision of a genus is transferred to another genus (or placed under another generic name for the same genus) without change of rank, its subdivisional name must be retained, or (if it has not been retained) must be re-established unless one of the following obstacles exists: (1) that the resulting association of names has been previously published validly for a different subdivision, or (2) that there is available an earlier validly published subdivisional name of the same rank. E. g. *Saponaria* sect. *Vaccaria* DC., transferred to *Gypsophila*, becomes *Gypsophila* sect. *Vaccaria* (DC.) Gren. & Godr.

Art. 54. When a species is transferred to another genus (or placed under another generic name for the same genus), without change of rank, the specific epithet must be retained or (if it has not been retained) must be re-established, unless one of the following obstacles exists: (1) that the resulting binary name has been previously and validly published for a different species, (2) that there is available an earlier validly published specific epithet.

When the specific epithet, on transference to another genus, has been applied erroneously in its new position to a different plant, it must be retained for the plant on which the group was originally based: e. g. the specific epithet of *Pinus Mertensiana* Bong. was transferred to *Tsuga* by Carrière, who, however, erroneously applied the new combination *Tsuga Mertensiana* to another species of *Tsuga*, namely, *T. heterophylla* (Raf.) Sarg., as is evident from his description: the epithet *Mertensiana* (Bong.) must be retained for *Pinus Mertensiana* Bong. when that species is transferred to *Tsuga;* the citation in parentheses (under Art. 49) of the name of the original author, Bongard, indicates the type of the epithet, *Tsuga Mertensiana* (Bong.) Sargent, non Carrière.

Art. 55. When a variety or other subdivision of a species is transferred, without change of rank, to another genus or species (or placed under another generic or specific name for the same genus or species), the original subdivisional epithet must be retained or (if it has not been retained) must be re-established, unless one of the following obstacles exists: (1) that the resulting ternary combination has been previously and validly published for a subdivision based on a different type, even if that subdivision is of a different rank; (2) that there is an earlier validly published subdivisional epithet available.

When the epithet of a subdivision of a species, on transference to another species, has been applied erroneously in its new position to a different plant, the epithet must be retained for the plant on which the group was originally based.

Example: The variety *micranthum* Gren. & Godr. (*Fl. France,* i, 171: 1847) of *Helianthemum italicum* Pers., when transferred as a variety to *H. penicillatum* Thib., retains its varietal epithet, becoming *H. penicillatum* var. *micranthum* (Gren. & Godr.) Grosser (in Engl. *Pflanzenreich,* Heft 14, 115: 1903).

Section 10.—**Choice of Names when two Groups of the same Rank are united, or in Fungi with a pleomorphic Life-cycle** (Art. 56, 57, Rec. XXXIII–XXXV).

Art. 56. When two or more groups of the same rank are united the oldest legitimate name or (in species and their subdivisions) the oldest legitimate epithet is retained. If the names or epithets are of the same date, the author who unites the groups has the right of choosing one of them. The author who first adopts one of them, definitely treating another as a synonym or referring it to a subordinate group, must be followed.

Recommendations:

XXXIII. Authors who have to choose between two generic names should note the following recommendations:—

1. Of two names of the same date to prefer the one which was first accompanied by the description of a species.
2. Of two names of the same date, both accompanied by descriptions of species, to prefer the one which, when the author made his choice, included the larger number of species.
3. In cases of equality from these various points of view to prefer the more correct and appropriate name.

XXXIV. When several genera are united as subgenera or sections under one generic name, the subdivision including the type of the generic name used may bear that name unaltered (e. g. *Anarrhinum* sect. *Anarrhinum*), or with a prefix (*Anthriscus* sect. *Eu-Anthriscus*), or a suffix (*Stachys* sect. *Stachyotypus*). These prefixes or suffixes lapse when the subdivisions are raised to generic rank.

XXXV. When several species are united as subspecies or varieties under one specific name, the subdivision which includes the type of the specific epithet used may be designated either by the same epithet unaltered (e. g. *Stachys recta* subsp. *recta*), or with a prefix (e. g. *Alchemilla alpina* subsp. *eu-alpina*), or by one of the customary epithets (*typicus, originarius, genuinus, verus, veridicus,* etc.), indicating that it is the type subdivision.

Art. 57. Among Fungi with a pleomorphic life-cycle the different successive states of the same species (*anamorphoses, status*) can bear only one generic and specific name (binary), that is the earliest which has been given, starting from Fries, *Systema,* or Persoon, *Synopsis,* to the state containing the form which it has been agreed to call the perfect form, provided that the name is otherwise in conformity with the Rules. The perfect state is that which ends in the ascus stage in the *Ascomycetes,* in the basidium in the *Basidiomycetes,* in the teleutospore or its equivalent in the *Uredinales,* and in the spore in the *Ustilaginales.* Generic and specific names given to other states have only a temporary value. They cannot replace a generic name already existing and applying to one or more species, any one of which contains the "perfect" form.

The nomenclature of Fungi which have not a pleomorphic life-cycle follows the ordinary rules.

Section 11.—**Choice of Names when the Rank of a Group is changed.**

Art. 58. When a tribe becomes a family, when a subgenus or section becomes a genus, when a subdivision of a species becomes a species, or when the reverse of these changes takes place, and in general when a group changes its rank, the earliest legitimate epithet given to the group in its new rank is valid, unless that name or the resulting association or combination is a later homonym (see Art. 60, 61). E. g. the section *Campanopsis* R. Br. (*Prodr. Fl. Nov. Holl.* 561: 1810) of the genus *Campanula* was first raised to generic rank by Schrader, and as a genus must be called *Wahlenbergia* Schrad. (*Cat. Hort. Goett.*: 1814), not *Campanopsis* (R. Br.) O. Kuntze (*Rev. Gen.* ii, 378: 1891).

Recommendation XXXVI. 1. When a sub-tribe becomes a tribe, when a tribe becomes a subfamily, when a subfamily becomes a family, etc., or when the inverse changes occur, the root of the name should not be altered but only the termination (*-inae, -eae, -oideae, -aceae, -ineae, -ales,* etc.), unless the resulting name is rejected under Section 12 or the new name becomes a source of error or there is some other serious reason against it.

2. When a section or a subgenus becomes a genus, or the inverse changes occur, the original name should be retained unless it is rejected under Section 12.

3. When a subdivision of a species becomes a species, or the inverse change occurs, the original epithet should be retained unless the resulting combination is rejected under Section 12.

Section 12.—**Rejection of Names** (Art. 59–69, Rec. XXXVII).

Art. 59. A name or epithet must not be rejected, changed, or modified merely because it is badly chosen, or disagreeable, or because another is preferable or better known (see also Art. 69).

Art. 60. A name must be rejected if it is illegitimate (see Art. 2). The publication of an epithet in an illegitimate combination must not be taken into consideration for purposes of priority (see Art. 45).

A name is illegitimate in the following cases:—

(1) If it was superfluous when published, *i. e.* if there was a valid name (see Art. 16) for the group to which it was applied, with its particular circumscription, position and rank.

(2) If it is a binary or ternary name published in contravention of Art. 16, 50, 52 or 54, *i. e.* if its author did not adopt the earliest legitimate epithet available for the group with its particular circumscription, position, and rank.

(3) If it is a later homonym (see Art. 61) (except as regards Art. 54 and 55).

(4) If it is a generic name which must be rejected under Art. 67.

(5) If its specific epithet must be rejected under Art. 68.

Art. 61. A name of a taxonomic group is illegitimate and must be rejected if it is a *later homonym*, that is, if it duplicates a name previously and validly published for a group of the same rank based on a different type. Even if the earlier homonym is illegitimate, or is generally treated as a synonym on taxonomic grounds, the later homonym must be rejected.

Examples: The generic name *Tapeinanthus* Boiss. ex Benth. (1848), given to a genus of *Labiatae,* is a later homonym of *Tapeinanthus* Herb. (1837), a name previously and validly published for a genus of *Amaryllidaceae; Tapeinanthus* Boiss. ex Benth. must, therefore, be rejected, as was done by Th. Durand (*Ind. Gen. Phan.* 703: 1888) who renamed it *Thuspeinanta.*—The generic name *Amblyanthera* Müll. Arg. (1860) is a later homonym of the validly published generic name *Amblyanthera* Blume (1849), and must, therefore, be rejected, although *Amblyanthera* Blume is now reduced to *Osbeckia* L. (1753).—*Astragalus rhizanthus* Boiss. (*Diagn. Fl. Or.* ser. 1, ii, 83: 1843) is a later homonym of the validly published name *Astragalus rhizanthus* Royle (*Illstr. Bot. Himal.* 200: 1835), and it must, therefore, be rejected, as was done by Boissier, who renamed it *A. cariensis* (*Diagn.* ser. 1, ix, 57: 1849).

Note.—Mere orthographic variants of the same name are treated as homonyms —see Art. 70.

Art. 62. A name of a taxonomic group must be rejected if, owing to its use with different meanings, it becomes a permanent source of confusion or error. A list of names to be abandoned for this reason (*Nomina ambigua*) will form Appendix IV.

Examples: The generic name *Alsine* L., being used by various authors for three genera of *Caryophyllaceae* (*Stellaria* L., *Spergularia* J. & C. Presl, *Minuartia* L.), has been a permanent source of confusion and error (see Sprague in "Kew Bulletin," 1920, 308).—The name *Rosa villosa* L., *Sp. Pl.* ed. 1, 491 (1753), is rejected, because it has been applied to several different species, and has become a source of confusion.

Art. 63. A name of a taxonomic group must be rejected when its application is uncertain (*nomen dubium*): e. g. *Ervum soloniense* L. (*Cent. II. Pl.* 28: 1756) is a name the application of which is uncertain; it must, therefore, be rejected (see Schinz and Thell. in *Vierteljahresschr. Nat. Ges. Zürich,* lviii, 71: 1913).

Recommendation XXXVII. When the correct application of a *nomen dubium* has been established by subsequent investigation (of types, etc.), authors adopting it should, for purposes of precision, cite the name of the author who published the additional certifying evidence as well as that of the original author. It is also desirable to add the date of certification.

Art. 64. A name of a taxonomic group must be rejected if the characters of that group were derived from two or more entirely discordant elements, especially if those elements were erroneously supposed to form part of the same individual: e. g. the characters of the genus *Schrebera* L. (*Sp. Pl.* ed. 2, 1662; 1763; *Gen. Pl.* ed. 6, 124: 1764) were derived from the two genera *Cuscuta* and *Myrica* (parasite and host), see Retzius (*Obs.* vi, 15: 1791). A list of names to be abandoned for this reason (*Nomina confusa*) will form Appendix VI.

Art. 65. A name or epithet of a taxonomic group must be rejected when it is based on a monstrosity.

Art. 66. The name of an order, suborder, family or subfamily, tribe or subtribe must be changed when it is taken from the name of a genus which is known not to belong to the group in question—e. g. if the genus *Portulaca* were excluded from the family now known as *Portulacaceae,* the residual group could no longer bear the name *Portulacaceae,* and would have to be renamed.

Art. 67. Names of genera are illegitimate in the following *special* cases and must be rejected:—

(1) When they are merely words not intended as names: e. g. *Anonymos* Walt. (*Fl. Carol,* 2, 4, 9, etc.: 1788) must be rejected as being a word applied to 28 different genera by Walter to indicate that they were without names.

(2) When they coincide with a technical term currently used in morphology unless they were accompanied, when originally published, by specific names in accordance with the binary method of Linnæus. On and after Jan. 1, 1912, all new generic names coinciding with such technical terms are unconditionally rejected.

(3) When they are unitary designations of species: e. g. Ehrhart (*Phytophylacium:* 1780; and *Beitr.* iv, 145-150: 1798) proposed unitary names for various species known at that time under binary names: e. g. *Phaeocephalum* for *Schoenus fuscus,* and *Leptostachys* for *Carex leptostachys.* These names, which resemble generic names, should not be confused with them, and must be rejected, unless they have been published as generic names by a subsequent author.

(4) When they consist of two words, unless these words were from the first combined into one, or joined by a hyphen.

Art. 68. Specific epithets are illegitimate in the following cases and must be rejected:—

(1) When they are merely words not intended as names: e. g. *Viola "qualis"* Krocker (*Fl. Siles.* ii, 512 and 517: 1790); *Atriplex "nova"* Winterl (in *Ind. Hort. Bot. Univ. Pest.* fol. A 8, recto et verso: 1788), the word *"nova"* being here used in connection with four different species of *Atriplex.*

(2) When they are merely ordinal adjectives being used for enumeration.

(3) When they exactly repeat the generic name with or without the addition of a transcribed symbol.

(4) When they were published in works in which the Linnean system of binary nomenclature for species was not consistently employed.

Art. 69. It cases foreseen in Art. 60-68 the name or epithet to be rejected is replaced by the oldest legitimate name, or (in a combination) by the oldest legitimate epithet. If none exists, a new name or epithet must be chosen. Where a new epithet is required, an author may, if he wishes, adopt an epithet previously given to the group in an illegitimate combination, if there is no obstacle to its employment in the new position or sense.

Section 13.—**Orthography of Names** (Art. 70, 71, Rec. XXXVIII-XLIV).

Art. 70. The original spelling of a name or epithet must be retained, except in the case of a typographic error, or of a clearly unintentional orthographic error. When the difference between two generic names lies in the termination, these names must be regarded as distinct, even though differing by one letter only. This does not apply to mere orthographic variants of the same name.

Note 1. The words "original spelling" in this Article mean the spelling employed when the name was validly published.

2. The use of a wrong connecting vowel or vowels (or the omission of a connecting vowel in a specific epithet, or in that of a subdivision of a species) is treated as an unintentional orthographic error which may be corrected (see Rec. XLIV).

3. In deciding whether two or more slightly different names should be treated as distinct or as orthographical variants, the essential consideration is whether they may be confused with one another or not: if there is serious risk of confusion, they should be treated as orthographic variants. Doubtful cases should be referred to the Executive Committee.
4. Specific and other epithets of Greek origin differing merely by having Greek and Latin terminations respectively are orthographic variants. Epithets bearing the same meaning and differing only slightly in form are (considered as) orthographic variants. The genetive and adjectival forms of a personal name are, however, treated as different epithets (e. g. *Lysimachia Hemsleyana* and *L. Hemsleyi*).

Recommendations:

XXXVIII. When a new name is derived from a Greek word containing the *spiritus asper* (rough breathing), this should be transcribed as the letter *h*.

XXXIX. When a new name for a genus, subgenus or section is taken from the name of a person, it should be formed in the following manner:—

(*a*) When the name of the person ends in a vowel the letter *a* is added (thus *Ashbya* after Ashby; *Blakeslea* after Blakeslee), except when the name already ends in *a*, when *ea* is added (e. g. *Collaea* after Colla).

(*b*) When the name of the person ends in a consonant, the letters *ia* are added (e. g. *Magnusia* after Magnus, *Guilliera* after Guillier), except when the name ends in *er*, when *a* is added, e. g. *Kernera* after Kerner).

(*c*) The syllables which are not modified by these endings retain their original spelling, even with the consonants *k* and *w* or with groupings of vowels which were not used in classical Latin. Letters foreign to botanical Latin should be transcribed, and diacritic signs suppressed. The Germanic ä, ö, ü become *ae, oe, ue;* the French é, è, ê become generally *e*. In works in which diphthongs are not represented by special type, the diaeresis sign should be used where required, e.g. *Cephaëlis,* not *Cephaelis.*

(*d*) Names may be accompanied by a prefix or a suffix, or modified by anagram or abbreviation. In these cases they count as different words from the original name.

Examples: *Durvillea* and *Urvillea; Lapeyrousea* and *Peyrousea; Bouchea* and *Ubochea; Gerardia* and *Graderia; Thaxtera, Thaxteriola.*

XL. When a new specific or other epithet is taken from the name of a man, it should be formed in the following manner:—

(*a*) When the name of the person ends in a vowel, the letter *i* is added (thus *Caoi* from Cao), except when the name ends in *a*, when *e* is added (thus *Faverae* from Favera).

(*b*) When the name ends in a consonant, the letters *ii* are added (thus *Magnusii* from Magnus, *Guilliermondii* from Guilliermond), except when the name ends in *-er,* when *i* is added (thus *Thaxteri* from Thaxter).

(c) The syllables which are not modified by these endings retain their original spelling, even when the consonants *k* or *w* or with groupings of vowels which were not used in classical Latin. Letters foreign to botanical Latin should be transcribed and diacritic signs suppressed. The Germanic ä, ö, ü become *ae, oe, ue,* the French é, è, ê become generally *e*. The diaeresis sign should be used where required.

(*d*) When epithets taken from the name of a person have an adjectival form they are formed in a similar way (e. g. *Geranium Robertianum, Verbena Hasslerana*).

XLI. The same provisions apply to epithets formed from the names of women. When these have a substantival form they are given a feminine termination (e. g. *Cypripedium Hookerae, Rosa Beatricis, Scabiosa Olgae, Omphalodes Luciliae.*)

XLII. New specific (or other) epithets should be written in conformity with the original spelling of the words from which they are derived and in accordance with the rules of Latin and latinization.

Examples: *silvestris* (not *sylvestris*), *sinensis* (not *chinensis*).

XLIII. Specific (or other) epithets should be written with a small initial letter, except those which are derived from names of persons (substantives or adjectives) or are taken from generic names (substantives or adjectives).

XLIV. In the formation of specific (or other) epithets composed of two or several roots taken from Latin or Greek, the vowel placed between the two roots becomes a connecting vowel, in Latin *i*, in Greek *o;* thus *menthifolia, salviifolia,* not *Menthaefolia, salviaefolia.* When the second root begins with a vowel and euphony requires, the connecting vowel should be eliminated (e. g. *lepidantha*). The connecting vowels *ae* should be retained only where this is required for etymological reasons (e. g. *caricaeformis* from *Carica,* in order to avoid confusion with *cariciformis* from *Carex*). In certain compounds of Greek words no connecting vowel is required, e. g. *brachycarpus* and *glycyphyllus.*

Art. 71. When the spelling of a generic name differs in Linnæus' *Species Plantarum,* ed. 1, and *Genera Plantarum,* ed. 5, the correct spelling is determined by the following regulations:—

(1) If Linnæus subsequently to 1753-54 consistently adopted one of the spellings, that spelling is accepted, e. g. *Thuja* (not *Thuya*).

(2) If Linnæus did not do so, then the spelling which is more correct philologically is accepted, e. g. *Agrostemma* (not *Agrostema*).

(3) If the two spellings are equally correct philologically, and there is a great preponderance of usage in favor of one of them, that one is accepted, e. g. *Rhododendron* (not *Rhododendrum*).

(4) If the two spellings are equally correct philologically and there is not a great preponderance of usage in favor of one of them, then the spelling that is in accordance or more nearly in accordance with the Recommendations is accepted, e. g. *Ludwigia* (not *Ludvigia*), *Ortegia* (not *Ortega*).

Section 14.—**Gender of Generic Names.**

Art. 72. The gender of generic names is governed by the following regulations:—

(1) A Greek or Latin word adopted as a generic name retains the gender assigned to it by its author: e. g. *Orchis* (f.), *Stachys* (f.).

(2) Generic names which are modern compounds formed from two or more Greek or Latin words take the gender of the last. If the ending is altered, however, the gender will follow it.

Examples of names formed from Greek* words: The generic name *Andropogon* L. was treated by Linnæus as neuter, but it, like all other modern compounds in which the Greek masculine word *pogon* is the final element (e. g. *Centropogon, Cymbopogon, Rhizopogon*), is now treated as masculine. Similarly all modern compounds ending in *-codon, -myces, -odon, -panax, -stemon* and other masculine words are masculine. The generic name *Dendromecon* Benth., *Eomecon* Hance and *Hesperomecon* E. L. Greene are treated as feminine, because they end in the Greek feminine word *mecon,* poppy: the fact that Bentham and E. L. Greene respectively ascribed the neuter gender to the names *Dendromecon* and *Hesperomecon* is immaterial. Similarly all modern compounds ending in *-achne, -carpha, -cephala, -chlamys, -daphne* and other feminine words are treated as feminine.

---

*Examples of names formed from Latin words are not given, as these offer few difficulties.

The generic names *Aceras* R. Br., *Aegiceras* Gaertn. and *Xanthoceras* Bunge are neuter because they end in the Greek neuter word *ceras;* the fact that Robert Brown and Bunge respectively made *Aceras* and *Xanthoceras* feminine is immaterial. Similarly all modern compounds ending in *-dendron, -nema, -stigma, -stoma* and other neuter words are neuter. Names ending in *-anthos* (or *anthus*) and those in *-chilos* (or *-chilus*) ought strictly speaking to be neuter, since that is the gender of the Greek words *anthos* and *cheilos.* These names, however, have been with very few exceptions treated as masculine, hence it is agreed to assign that gender to them. Similarly those ending in *-gaster,* which should strictly speaking be feminine, are treated as masculine in accordance with botanical custom.

Examples of compound generic names where the termination of the last word is altered: *Hymenocarpus, Dipterocarpus* and all other modern compounds ending in the Greek masculine *carpos* (or *carpus*) are masculine. Those in *-carpa* or *-carpaea,* however, are feminine, e. g. *Callicarpa* and *Polycarpaea;* and those in *-carpon, -carpum* or *-carpium* are neuter, e. g. *Polycarpon, Ormocarpum* and *Pisocarpium.*

(3) Arbitrarily formed generic names or vernacular names used as generic names take the gender assigned to them by their authors. Where the original author has failed to indicate the gender, the next subsequent author has the right of choice.

Examples: *Taonabo* Aubl. (*Hist. Pl. Guiane,* i, 569: 1775) is feminine; Aublet's two species were *T. dentata* and *T. punctata.*—*Agati* Adans. (*Fam.* ii, 326: 1763) was published without indication of gender: the feminine gender was assigned to it by Desvaux (*Journ. Bot.* i, 120: 1813), who was the first subsequent author to adopt the name, and his choice is decisive.

Section 15.—**Various Recommendations** (Rec. XLV-L).

XLV. When writing in modern languages botanists should use Latin scientific names or those immediately derived from them, in preference to names of another kind or origin (popular names). They should avoid the use of the latter unless these are very clear and in common use.

XLVI. Every friend of science should oppose the introduction into a modern language of names of plants which are not already there, unless they are derived from Latin botanical names by means of some slight alteration.

XLVII. Only the metric system should be used in botany for reckoning weights and measures. The foot, inch, line, pound, ounce, etc., should be rigorously excluded from scientific language.

Altitude, depth, rapidity, etc., should be measured in metres. Fathoms, knots, miles, etc., are terms which should disappear from scientific language.

XLVIII. Very minute dimensions should be reckoned in μ (micromillimetres, microns, or thousandths of a millimetre) and not in fractions of millimetres or of lines, etc.; fractions encumbered with ciphers and commas easily give rise to mistakes.

XLIX. Authors should indicate clearly and precisely the scale of the figures which they publish.

L. Temperatures should be expressed in degrees of the centigrade thermometer of Celsius.

Chapter IV.—INTERPRETATION AND MODIFICATION OF THE RULES (Art. 73, 74).

Art. 73. A small permanent International Executive Committee is established with functions including the following:—

(1) Interpreting the Rules in doubtful cases, and issuing considered "Opinions" on the basis of the evidence submitted.

(2) Considering *Nomina conservanda, Nomina ambigua, Nomina dubia* and *Nomina confusa,* and making recommendations thereon to the next International Botanical Congress.

(3) Considering all proposals for the modification of the Rules and reporting thereon to the next Congress.

(4) Reporting on the effects of modifications of the Rules accepted at the preceding Congress.

Art. 74. These Rules can be modified only by competent persons at an International Botanical Congress convened for the express purpose. Modifications accepted at one Congress remain on trial until the next Congress, at which they will receive sanction unless undesirable consequences, reported to the Executive Committee, show need for further amendment or rejection.

*Appendix I.—Regulations for determining types.
*Appendix II.—Nomina conservanda familiarum.
Appendix III.—Nomina generica conservanda.
*Appendix IV.—Nomina ambigua.
*Appendix V.—Nomina dubia.
*Appendix VI.—Nomina confusa.
*Appendix VII.—Representative Botanical Institutions recognized under Art. 34.
Appendix VIII.—Nomenclature of Garden Plants.

---

*Drafts of these Appendixes will be prepared for submission to the next International Congress.

CHAPTER VII

MUCORALES

In the Mucorales or Zygomycetes, the thallus is usually coenocytic, although in some of the higher forms it is secondarily divided into cells. Under certain conditions the hyphae may fragment into hyphal bodies, etc., which occasionally develop further as sprout mycelia. In an extremely unfavorable environment, small portions of hyphae develop into thick-walled chlamydospores.

In most forms the reproductive structures are aerial. The haploid mycelium produces sporangia or conidia, the diploid mycelium produces zygospores. Sporangia are typical of the Mucoraceae and the Endogonaceae, conidia of the Entomophthoraceae, a group of parasites upon insects. The sporangia form nonmotile, endogenous sporangiospores. In the successively higher genera there is a tendency for reduction in the number of sporangiospores produced by a sporangium until the sporangium is practically reduced to the level of a conidium which produces mycelium directly without the medium of a spore formation.

The sexual act is essentially isogamous in spite of heterothallism. The higher Mucorales tend more and more toward heterogamy. The products of the sexual act, the zygospores, are primarily resting spores and have never been reported in many species.

The relationships of the Mucorales are wholly obscure. Vuillemin (1886, 1912) and Lotsy (1907) connect this order through *Basidiobolus,* a genus dividing its life cycle between the digestive tracts of beetles and frogs, to the Conjugales of the green algae and derive the other Entomophthoraceae and Mucoraceae from this genus. Davis (1903) considers in general terms the green algae, especially the isogamous forms, such as *Cladophora* or the Siphonales. As intermediate forms are wholly lacking and apparently such simple structures as the Mucoraceous sporangium are still unknown in other groups, phylogenetic speculation is unfruitful. The present tendency is to connect the Mucorales with the more primitive Phycomycetes. It is quite possible that the Mucorales include phylogenetically heterogeneous organisms, which are only similar in the copulation of their coenocytic gametangia.

In their classification the Mucorales are divided into two groups, one of which forms sporangia, the other conidia. The sporangial group includes the large family of Mucoraceae and a small family, the Endogonaceae, consisting of small, truffle-like fungi usually growing under leaf mold or in the soil. The conidial group contains the Entomophthoraceae consisting of two tribes, the Basidioboleae found in the intestinal tracts of beetles and amphibia and the Entomophthoreae mostly parasitic on living insects, although capable of continuing growth and reproduction saprophytically on dead insects. Only the Mucoraceae have been found parasitic on mammals. *Basidiobolus hominis* has recently been reported but has been so poorly described that its relationships are still obscure.

Mucoraceae.—This family is commonly saprophytic on plant or animal remains, more rarely parasitic on other Mucoraceae, on higher plants, or on animals. They play a large part in the decay of organic substances and a few species have some economic importance because of fermentations, such as alcoholic fermentation by *Mucor javanicus* or starch hydrolysis by *Rhizopus Oryzae* (Wehmer 1907).

Except in *Haplosporangium,* where the hyphae are early divided into multinucleate segments by septa, the thallus consists of branched coenocytic hyphae without septa; in senescence or in the development of reproductive structures, septa are formed irregularly to cut off older vacuolate sections from the younger portions. Furthermore, the hyphae of some genera, in high concentrations of sugars and anaerobic conditions, break up into oidia which may develop further by sprouting; this sprout mycelium may ferment sugars very much as the true yeasts. (Fig. 2.) In *Mortierella* and *Syncephalis,* hyphal branches may fuse where they come in contact with each other, so that the mycelium becomes an anastomosing network. In general, heterothallic species have no definite sexual dimorphism, the strains usually differing slightly in physiologic characters or the positive (female) strain being better developed.

Only a few details are known concerning the internal structure of the hyphae. The hyaloplasm of *Mortierella reticulata* and *Rhizopus nigricans* (Moreau 1913) contracts into peculiar strands parallel to the hyphal axis. The nuclei are very small throughout (1-3μ in diameter). They divide simultaneously, both directly and indirectly, in the same hyphal region.

The hyphae generally spread out evenly within and upon the substrate. *Rhizopus* and *Absidia* have more or less well-differentiated stolons, each consisting of a node provided with appressoria or holdfasts, from which radiate new stolons. The appressoria of the forms parasitic on other Mucoraceae are further modified; thus in *Mortierella Bainieri* they grasp the host hyphae as claws or spirals, and in *Piptocephalis Freseniana,* they penetrate the interior of the hypha and there branch into a small tuft, as haustoria.

Thick-walled hypnospores are formed under unfavorable conditions, while in *Mucor sphaerosporus* the mycelium may form true sclerotia. The hypnospores usually arise endogenously; multinucleate protoplasmic portions of varying circumference draw together and, inside the original hyphal membrane, surround themselves with a special thick wall (Fig. 3). The stipitate hypnospores (mycelial conidia or stylospores) of *Mortierella* (Fig. 8, *d*) and *Syncephalis* are cut off in scattered or racemose groups on short branches of the mycelium (H. Bachmann, 1900). Under suitable environmental conditions both hypnospores and sclerotia develop to new mycelia.

Asexual reproduction takes place through sporangia with sporangiospores. The parts of the mycelium from which the sporangia develop swell considerably, and their nuclei divide repeatedly. In forms with stolons, the sporangiophores branch almost exclusively from the nodes and are then firmly attached to the substrate by the group of rhizoids, but in *Absidia* they may branch directly from the stolons midway between nodes.

In the simpler species the sporangiophores are unbranched (Fig. 4, *7*); in the more highly organized, they are forked, racemose, corymbose, cincinnal, etc. (Fig. 4, *3*, *9*). The tip of each branch swells up to a sporangium, allowing

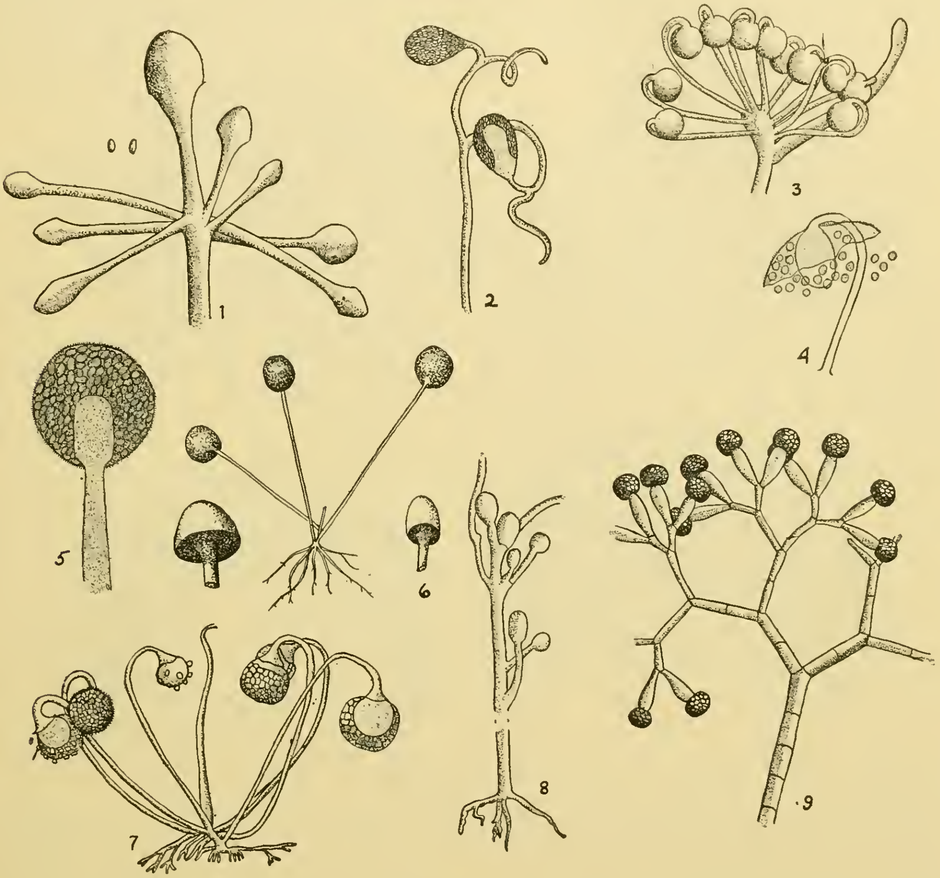

Fig. 4.—Sporangia. *1, Absidia Truchisi* (after Lucet & Costantin); *2, Pirella circinans* (after Bainier 1883); *3, 4, Circinella umbellata,* showing dehiscence and columella (after Tieghem 1873); *5, Mucor Mucedo* (after Brefeld 1872); *6, Rhizopus niger* (after Bainier); *7, Rhizopus reflexus* (after Bainier 1883); *8, Rhizopus parasiticus* (after Costantin 1900); *9, Sporodinia grandis* (after Lendner 1908).

the protoplasm of the swollen hyphal portion to migrate into it, and is finally abjointed (cut off by a septum). In the tribe, Mortierelleae, the septum is plane or slightly convex, in the Mucoreae it forms a dome projecting far into the sporangium. This dome is usually called a columella. It is generally smooth, cylindric or pyriform and remains attached to the stalk long after the spores are shed. In *Pilobolus roridus* (Tieghem 1875) and *Pilaira anomala*

(Brefeld 1881) on dung, the sporangiophore swells under the sporangium to a large head. On the absorption of more water, the sporangiophore bursts at the point of insertion of the columella, shooting off the sporangium and columella often to a height of one meter and with an audible sound.

In the Mucoreae the sporangial wall consists fundamentally of cellulose which subsequently is so incrusted with calcium oxalate crystals that it becomes fragile; simultaneously the cellulose is hydrolyzed to a more soluble hygroscopic compound, so that it finally dissolves and the crystals scatter. In the majority of genera, only the base of the sporangial wall remains, forming a basal collar about the columella. In the Mortierelleae the wall is equally soluble, but the oxalate crystals are not formed. In *Pilobolus* it is cuticularized, except at the base, and permanent.

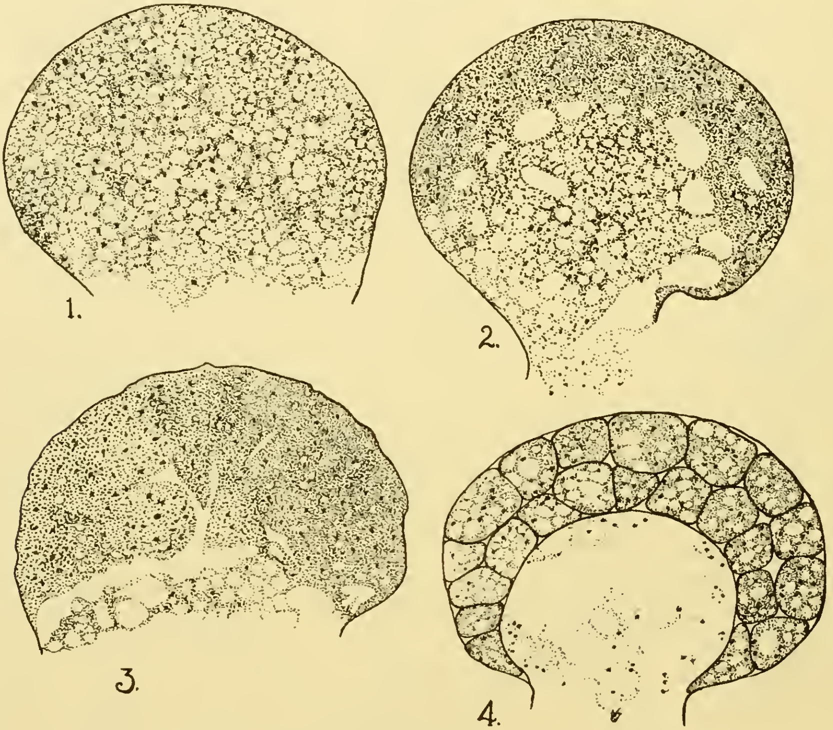

Fig. 5.—Showing the development of the sporangium of *Sporodinia grandis*. (After Harper 1899.)

At first, most of the cytologic processes within the sporangium are the same (Fig. 5, *1*). The content of the young swelling is divided into a central zone, filled mainly by sap and penetrated by a few protoplasmic threads, and a rich peripheral zone, containing most of the nuclei (Fig. 5, *2*). The border between the two is differentiated into a foamy protoplasmic layer permeated by narrow, flattened vacuoles. These fuse laterally and form between the vacuolate central portion and the protoplasmic periphery a cleavage cavity; its bordering surfaces are covered with a plasma membrane which is thickened into a wall on the side next the stalk. The central portion remains sterile and becomes the columella (Fig. 5, *4*). Its nuclei no longer show any membrane or nucleoli and degenerate, although occasionally fusions or amitotic divisions appear. The peripheral, spherical cap forms the fertile sporogenous layer.

There are three types of spore formation. In *Pilobolus crystallinus* (*P. microsporus*) and *P. oedipus* (Harper 1899) vacuoles divide the whole sporogenous protoplasm into uni-, rarely multinucleate, portions, the so-called protospores, which round up, swell, and undergo several nuclear divisions before separating into multinucleate portions. These portions again round off, are surrounded by a membrane, and become 2-spored. We shall find suggestions of this mode of spore formation in the Endomycetales. (*Coccidioides* and *Protomyces*, pp. 147, 157.)

In *Circinnella conica* (Moreau 1913) and *C. minor* (Schwarze 1922) development is simpler; here the protospores are surrounded by a membrane without further splitting and become spores directly. In most of the other genera, as in *Sporodinia* (Harper 1899), *Phycomyces, Rhizopus, Mucor, Absidia,* and *Zygorhynchus* (Swingle 1903, Moreau 1913, Green 1927), the protospore stage is omitted. The division of the nuclei in *Phycomyces,* probably also in the other genera, occurs simultaneously in the whole sporangium. The sporogenous protoplasm splits directly into multinucleate, rarely uninucleate, portions which round off, form a membrane, and develop directly into spores without further nuclear division. The unicellular sporangiospores are generally ellipsoid or spherical, hyaline or dully colored; resting free in the sporangium or embedded in a granular gel, probably developed from within themselves, which swells rapidly in water. At germination they swell considerably and develop into a mycelium through one or more germ tubes.

The original sporangial type discussed above, represented by *Mucor, Sporodinia,* etc., is modified in higher forms. Either the individualization of protospores is retarded without being suppressed or the sporangia decrease successively in differentiation, size, and spore number until they appear and function as conidia.

By retardation of spore formation we have a series from *Choanephora* to *Piptocephalis.* Poorly nourished individuals of *Choanephora cucurbitarum* exhibit sporangiophores and sporangia like those of *Mucor.* On the ends of the brown, smooth sporangiospores are 2-3 hyaline processes from each of which as many as 20 hairs may arise. Where there is abundant food supply, the spores develop, either on swollen tips of vertical hyphae or on the short secondary branches, exogenously by budding not endogenously by cleavage. Spore formation is ontogenetically retarded and transferred from the interior of the sporangium to its surface.

Exogenous spore formation appears more clearly in *Cunninghamella* investigated by Moreau (1913). In *C. echinulata* and *C. Bertholletiae,* the ends of the sporophores swell to sporangia whose content is differentiated into a watery inner, and a rich outer, zone. The peripheral layer pushes out into small spherical sacs on short sterigmata, with 3-8 nuclei each. These sacs are abjointed and transformed into spores, corresponding in size and form to those of *Mucor* but borne on the outer, rather than on the inner, surface of sporangia.

The series may be continued in *Blakeslea trispora* (Fig. 6). Under certain environmental conditions, e. g., saturated atmosphere, this species forms typical multispored sporangia with large pyriform columellas (Fig. 6, *1*). These sporangia show a marked tendency toward degeneration: with a slight alteration of cultural conditions, they decrease in size and spore number, and the columella shrinks or disappears. The resulting forms only distantly resemble the original sporangium (Fig. 6, *2*). Where conditions of growth are normal, the spore protoplasm migrates into protrusions, borne on spherical sterigmata (Fig. 6, *3*). Meridianal fission divides each of these into 3 spores adorned with little apical tufts of hair (Fig. 6, *5*). The mature protuberance separates from its sterigma or with its sterigma from the sporangium and is disseminated (Fig. 6, *4*). Here spore formation is further retarded; between

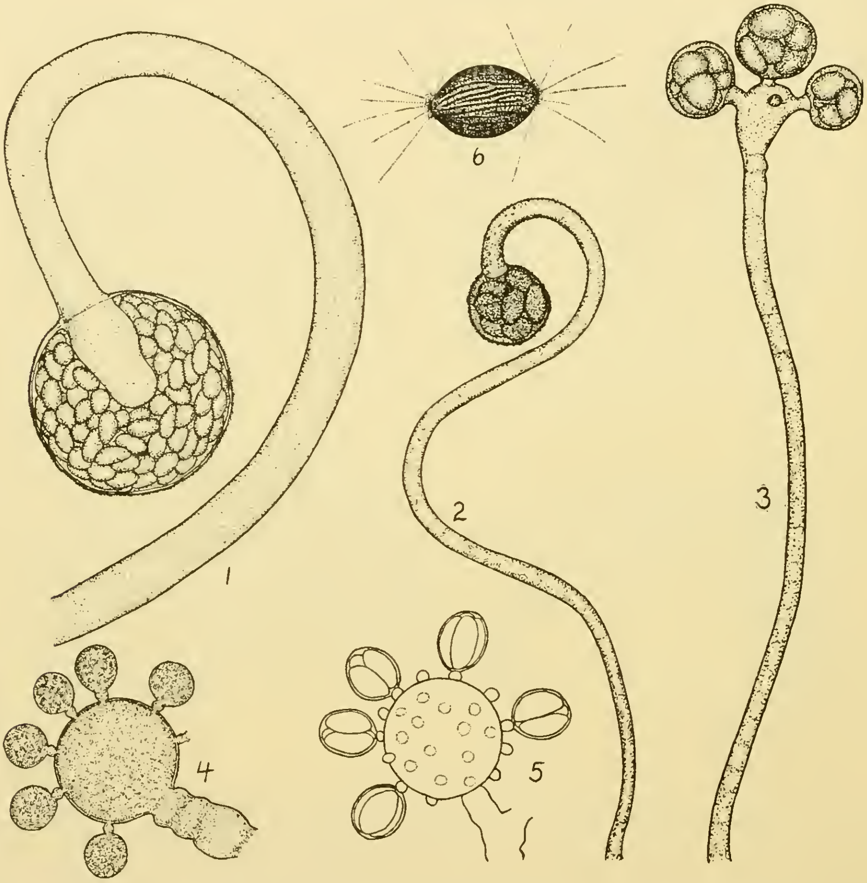

Fig. 6.—*Blakeslea trispora.* Modifications of sporangia: *1,* original form; *2,* reduced form without columella; *3-5,* formation of exogenous sporangioles; *6,* sporangiospore from sporangiole. (*1-5* ×260; *6* ×720.) (After Thaxter 1914.)

the differentiation of sporangial content into a sterile and a fertile zone and the individualization of single spores, the sporangium also develops into numerous "partial sporangia," each of which forms a small number of sporangiospores.

In *Syncephalastrum* the ability to form sporangia of the *Mucor* type has entirely disappeared, and the extramatrical partial sporangia have reached a higher stage of development (Fig. 7). Several palmately joined sterigmata develop into long cylindric tubes which receive as many as 20 nuclei each. When these have reached their full length, their content splits into uni- or multinucleate portions which round off and are surrounded by walls. The spores are finally liberated by the dissolution of the sporangial wall (Thaxter 1897, Moreau 1913).

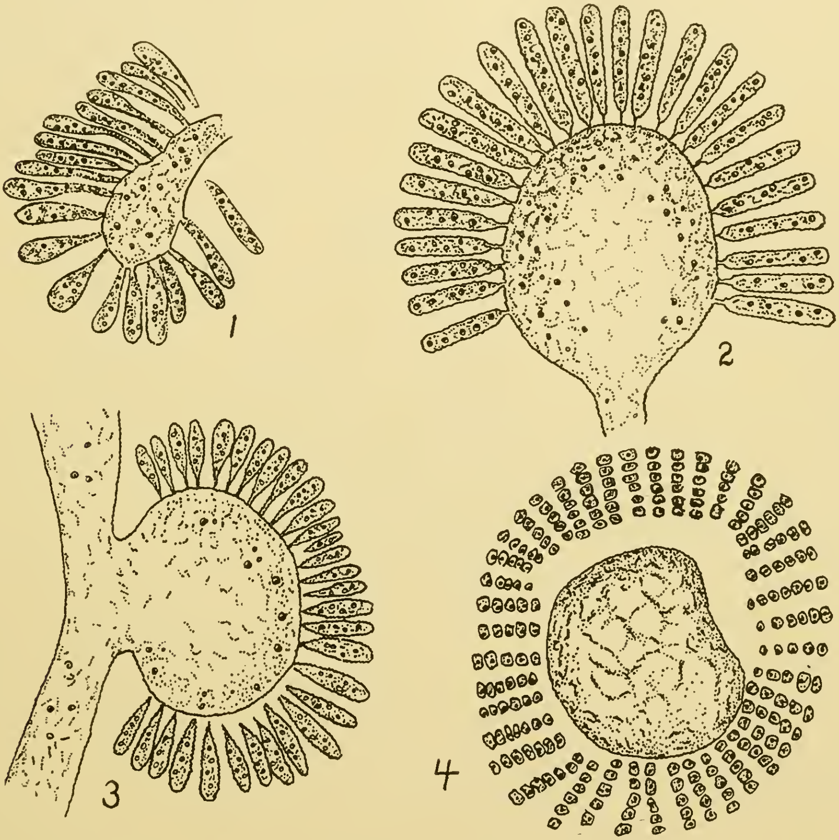

Fig. 7.—*Syncephalastrum cinereum.* Development of extramatrical partial sporangia. (×950.) (After Moreau 1914.)

In *Syncephalis,* after the destruction of the partial sporangium, the spores remain connected with the adjacent cufflike part of the sporangial wall; the spore wall itself remains thin and insignificant while the sporangial wall is thick and occasionally sculptured. In *S. aurantiaca,* the partial sporangia divide by septa into as many locules as there are spores. When these septa split, the partial sporangia divide into oidial members, each of which contains a spore; thus the spores are completely surrounded by a sporangial wall, inseparable from their own wall.

The functionless sporangium remains in open connection with the sporiferous hypha; it remains capitate and does not collapse until after the maturing of the partial sporangia. It may be regarded as a degenerate form only in so far as the sterile inner part is no longer separated from the peripheral spore protoplasm by the columellar wall. In *Piptocephalus*, the sporangium loses its capitate form, and shrinks to a verrucose basal cell, with an apical partial sporangium which the degeneration of the basal cell frees from the sporiferous hypha (Brefeld 1872, Tieghem 1875). The partial sporangia break up into monosporous members whose sporangial wall is fused with the spore membrane. The sporangiophores, therefore, have become conidiophores, recognizable as sporangiophores only through their phylogeny.

In the *Thamnidium-Chaetocladium* series, the sporangiospores are numerically much reduced, their functions being assumed by sporangia which successively degenerate to conidia. In *Thamnidium elegans*, the main axis possesses an apical multispored sporangium which has a columella. Under certain conditions, dichotomous branches terminating in sporangia are formed from the main axis. These sporangia, however, are smaller than the terminal ones, have no columella, become loosened as a whole from the sporangiophores, and contain few, generally 4, spores. Spores are liberated not by deliquescense but by disintegration of the sporangial wall. Such reduced sporangia are called **sporangioles.** The spores in both types of sporangia behave similarly as regards germination and further development. When well nourished, the sporangioles persist through several generations and finally become as large and multispored as the sporangia. Conversely, with poor food supply a terminal sporangium may turn into a sporangiole, often containing but one spore.

This line of development is continued through *Chaetostylum Fresenii* (*Thamnidium chaetocladioides*). Here true sporangia are borne only with adequate nourishment, while where the food supply is limited, the terminal sporangia abort.

The terminal sporangia which have declined in these two species, disappear in *Chaetocladium,* where the sporangioles also degenerate. They become monosporous, the spore membranes fusing with sporangial walls. In *Chaetocladium Jonesii* this double nature of the spore wall is evident, for on germination the sporangial wall separates from the spore. In *C. Brefeldii,* however, this differentiation disappears, and the germ tubes protrude directly from the wall. Again the sporangium has been transformed to a conidium.

In another series, *Mortierella* and *Haplosporangium* show a similar degeneration. The sporangium of *Mortierella* is separated from the sporangiophore by a septum (Fig. 8). Since its contents are not differentiated into fertile and sterile zones, the spores arise directly by cleavage of the whole protoplasm. Their number is notably reduced, in some species to 2 or 4. *Haplo-*

sporangium bisporale (Thaxter 1914) exhibits this condition as a general rule. The sporangia remain very small and retain only 1 or 2 spores. The spore wall is delicate, the sporangial wall thick and sculptured. The same process of reduction as in the unrelated *Thamnidium* and *Chaetocladium* has occurred here and has led to the formation of 1- or 2-spored sporangioles, biologically functioning as conidia.

Both sexual and asexual reproduction are known in most Mucoraceae. The type of reproduction in the homothallic forms depends mainly on conditions of nutrition; the heterothallic forms require the presence of both sexes. Mycelia of one sex may be cultivated alone indefinitely without the appearance of normal sexual reproduction, which appears promptly whenever the opposite sex is brought into the vicinity.

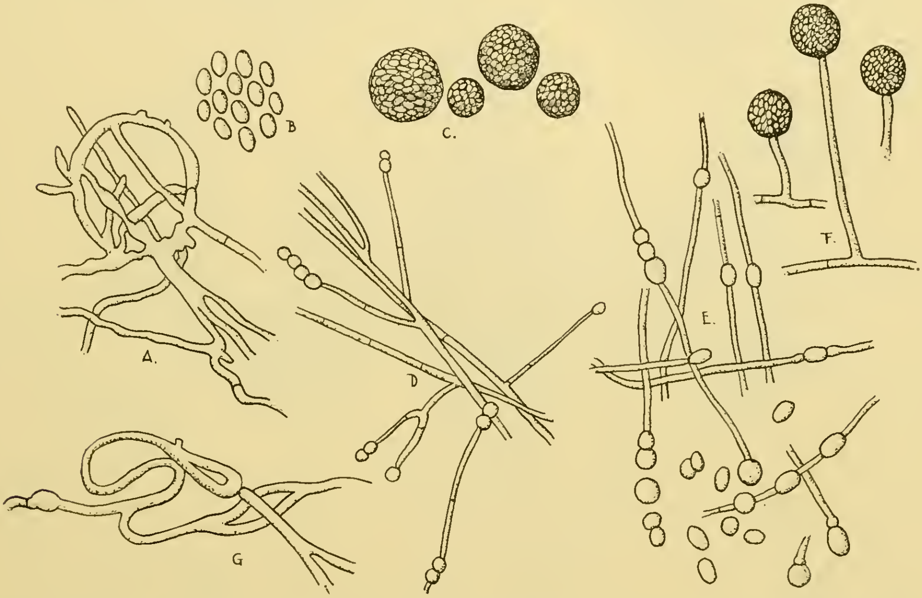

Fig. 8.—*Mortierella niveovelutina.* *a, g,* hyphal anastomosis; *b,* sporangiospore; *c,* sporangia; *d,* stylospores or aerial conidia; *e,* chlamydospores; *f,* sporangia attached to sporangiophores.

When the environmental conditions are favorable, the mutual approach of two sexually mature (in heterothallic forms also dynamically opposite) hyphae results in the formation of outgrowths toward each other. Each outgrowth is cut off from the hypha close behind the tip by a septum laid down from the wall inwards. The tip cell is the gametangium, the hypha is the suspensor. As the homothallic forms are bisexual, apparently there occurs in their hyphae at sexual reproduction, a spatial separation of + and − energids. In some species, the copulating branches arise from ordinary hyphae, in others they are developed on special branches, the **zygophores** (Fig. 9).

The two separating walls between the gametangia are gradually dissolved from the middle toward the edge, and the zygote becomes a hypnospore by the formation of a many-layered wall. This spore is called a **zygospore.** In the homothallic species when the copulating branch finds no mate, the gametangium surrounds itself with a thick many-layered wall and is called an **azygospore** or, less properly, a **chlamydospore.** The same thing happens if the cultures are placed in an unfavorable environment, such as high temperatures. In the heterothallic forms, similar phenomena may occur if the

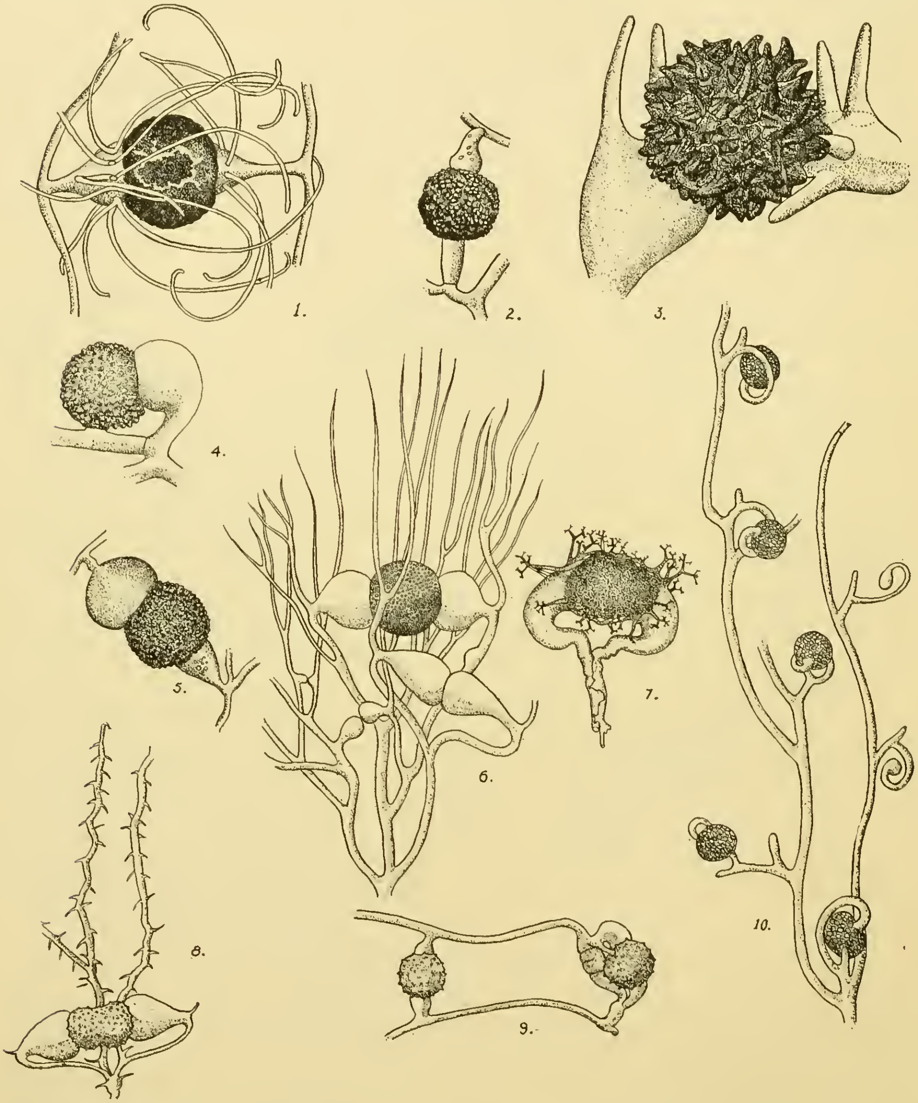

Fig. 9.—Zygospores. *1, Absidia glauca* (after Lendner) ; *2, Mucor hiemalis* (after Lendner 1908) ; *3, Parasitella simplex* (after Burgeff 1924) ; *4, Zygorhynchus heterogamus* (after Blakeslee 1913) ; *5, Rhizopus nigricans* (after Bary) ; *6, Sporodinia grandis* (after Bainier 1882) ; *7, Phycomyces nitens* (after Van Tieghem & Lemonier) ; *8, Spinellus fusiger* (after Bainier 1882) ; *9, Mucor racemosus* (after Bainier 1883) ; *10, Circinella spinosa* (after Bainier 1882).

copulating branches belong to two different species; in this case, they cease growing and transform the gametangia (in case they have already been cut off as such) into azygospores. This incomplete hybridization, however, does not seem to occur between all species, for, while it occurs between *Phycomyces nitens* + and *Mucor Mucedo* – and conversely, it does not between *Phycomyces nitens* and *Rhizopus nigricans* (Blakeslee 1904-1927).

While both gametangia are usually of the same size and thus externally suggest isogamy, in individual species their size relationships show a notable tendency to heterogamy. Thus, in the homothallic *Zygorhynchus Moelleri*, the copulating branches are unequally developed. In the heterothallic *Absidia Orchidis* the gametangia are of unequal diameter, the resulting zygospores being conic. In *Piptocephalis*, the zygospore grows upward from the point of fusion so that it is borne upon the top of the copulation branch. In *Syncephalis* *nodosa,* one copulation branch coils around the other in a helix (Thaxter 1897); the zygospore does not arise at the point of fusion but comparatively distant, on the outer portion of the helix near the septum separating the gametangium from the suspensor.

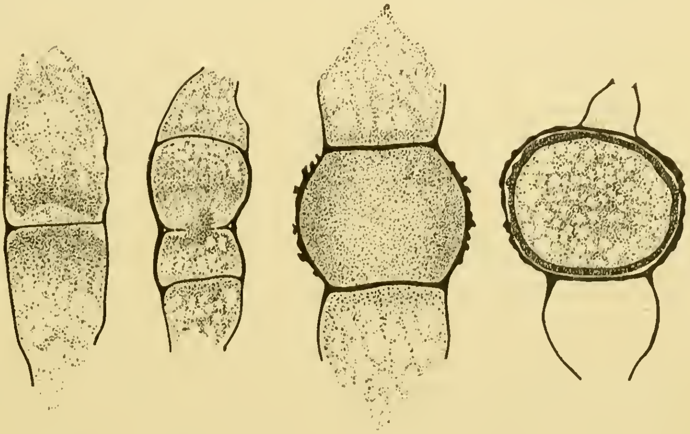

Fig. 10.—Development of the zygospore of *Sporodinia grandis.* (After Keene 1914.)

Cytologically all the above-mentioned processes behave similarly. *Sporodinia grandis* has been more complete studied. Its young gametangia contain more than a thousand nuclei each (Fig. 10). While the separating walls between the gametangia are dissolved, the nuclei undergo almost simultaneous division; their cytoplasm intermingles and their nuclei subsequently pair and fuse. Those without mates, especially those near the periphery, degenerate and disappear. Meanwhile at the surface a wall of several layers has been formed, the suspensors collapse, and the zygospores presently lie free upon their substrate.

It is characteristic of this process that no dynamic differentiation occurs between the + and – energids in spite of their spatial separation. Thus, both gametangia are cytologically equivalent, and fertilization is isogamous with reference to the nuclei. In *Sporodinia,* since there is no individualization of gametes, two coenocytic gametangia copulate and accomplish multiple fertilizations. In *Zygorrhynchus Dangeardi,* all but 4 gamete nuclei degenerate in the young zygote. The surviving four fuse in pairs very late after the endospore has been formed. A similar retardation of caryogamy has been observed in *Phycomyces nitens* (Burgeff 1915) in which the nuclei in zygospores 5 months old and ready to germinate, still lie in pairs.

The wall of the zygospores in the more carefully studied species of *Mucor, Sporodinia,* and *Zygorrhynchus* consists of 5 layers (Vuillemin 1904). The innermost layer is thin and granular; it forms the transition from the protoplasm and to a certain extent is the mother layer. The next is thickest and is called the cartilaginous layer on account of its elasticity. This is covered by a thin sheath, the middle cuticular layer. The fourth or carbonaceous layer is fragile and brown or black; the outermost cuticular layer is either pale and elastic, or dark and fragile, and often interrupted or fractured. The greatest modifications in the various genera are shown by the surface of the carbonaceous layer which is verrucose or reticulate. The two outer layers are grouped as the exospore, the three inner as the endospore.

In *Absidia* and *Phycomyces* the zygospores are loosely surrounded by branches from the suspensors (Fig. 9, *1, 7*). In *Mortierella* these branches intertwine with the neighboring hyphae into a solid felt whose outer surface is cuticularized and brown. Within this tissue lies the zygospore.

The zygospores germinate only after a long resting period. The exospore is ruptured, the endospore puts forth a germ tube which develops to a mycelium or, with insufficient nourishment, directly to a sporangium or a conidiophore.

During germination, meiosis of the diploid nuclei occurs. Where the germ tube becomes the fundament of a sporangium (e. g., *Phycomyces nitens,* Burgeff 1915) meiosis occurs only in the latter which is called a "germ sporangium," and as we shall see later is the precursor of the ascus. The sexual relationships existing at meiosis have been more closely studied for three types. (*Sporodinia, Mucor Mucedo,* and *Phycomyces nitens,* Blakeslee 1904, 1906.) In *Sporodinia* the sporangiospores are homothallic and the separation of the + and – energids occurs only in the formation of the copulation branches.

In the heterothallic *Mucor Mucedo* the separation of the + and – energids occurs probably in the formation of sporangia; i.e., the spores are all of one sex in one sporangium, either all + or all –.

In the equally heterothallic *Phycomyces nitens,* the separation of sexes occurs only in the formation of spores. Even so, it is incomplete; besides the + and – spores there are also unstable, neutral, bisexual spores in whose sporangia the separation into + and – spores is continued (Burgeff 1912).

Although some of the following characters are often unstable, they should be noted in the study of the Mucorales. The presence or absence of branching is often difficult to determine. Sometimes typical branching may be found in the small sporangiophores next the substrate, when it is not observed in the larger sporangiophores. If stolons are present, note their arrangement and the disposition of the sporangiophores upon them; also note the presence of holdfasts, etc. The nature of the medium influences the height of the sporangiophore, which should be determined only in cultures where optimum conditions of growth prevail. Malt gelatin (10%) or 10% gelatin to which has been added the residue of white wine from which the alcohol has been distilled, are suitable. The latter is known as Lendner's medium. Report the height of the sporangiophore from a colony cultivated at room temperature for at least 8 days, its diameter, the diameter of the sporangium (one of the larger ones), the height and diameter of the columella, the mean diameter of the spores (or their mean dimensions), and the diameter of zygospores and chlamydospores. The sporangial membrane may be diffluent, in which case, younger sporangia should be measured, or the sporangia mounted in a mixture of glycerol and water. If the membrane easily becomes fragmented, this should be noted. Note the presence or absence of a collar about the columella and the surface of the latter. Spore shape varies in the same sporangium. When a species is reported as having spherical spores, the majority are spherical, although oval or irregular spores may be present. Disregard variations in size unless they are extreme. To find hypnospores use cultures 2 weeks old or more on solid media or on liquid media with much sugar for sprouting cells. Note fermentations in case the sprout cells are abundant.

Classification.—There is still considerable disagreement among mycologists as to the subdivisions of this order. It is clearly divisible into three groups which the older mycologists considered families (Mucoraceae, Endogonaceae, and Entomophthoraceae). Some of the younger generation would elevate the old families to suborders, the latter two suborders containing a single family each, while the old tribes of the Mucoraceae are elevated to family rank (Fritzpatrick 1930). In any case only members of the tribe Mucoreae and Mortierelleae have so far been reported pathogenic and need be considered here. Since many of the saprophytic genera are difficult to define, and there are strong differences of opinion on synonymy, only the pathogenic genera which have been reported pathogenic to mammals are included in the following keys.

MUCORACEAE

Mycelium coenocytic, forming loose felted colonies; sporangiophores erect, often variously branched; sporangia usually with a columella (absent in *Mortierella*); sporangiophores abundant in the Mucoreae, in other tribes often reduced to a few spores in small sporangioles; zygospores resulting from the copulation of gametangia.

Key to Pathogenic Genera

Sporangium containing a columella; zygospore not surrounded by a layer of interwoven hyphae; sporangioles not formed, sporangial wall thin, not cutinized. *Mucoreae.*

- Sporangiophores arising directly from the mycelium, suspensors lacking outgrowths; gametangia essentially alike. *Mucor.*
- Sporangiophores arising from aerial arching stolons which develop rhizoids at points of contact with the substratum.
  - Sporangiophores borne on the arching internodes of the stolons between the nodes; sporangia pyriform; zygospores, when present, with prominent circinate outgrowths. *Absidia.*
  - Sporangiophores arising in a fascicle from the node of the stolon; sporangia spherical. *Rhizopus.*

Sporangium lacking a columella; zygospore where known enveloped by a thick layer of interwoven hyphae; sporangioles and conidia formed in some cases, when present isolated, not covering an enlargement on the sporangiophore or conidiophore; sporangiophore erect, tapering upward, usually not branched. *Mortierella.*

MUCOR

Mucor Micheli, NovaPlantarum Genera 215, 1729; Linné, Species Plantarum 1185, 1753; Gray, Natural Arrangement of British Plants **1**: 560, 1821; Fries, Systema Mycologicum **3**: 320, 1829.

Type species: *Mucor Mucedo L.*

Mycelium abundant both in and on the substratum, lacking stolons and rhizoids; sporangiophores occurring singly, erect, simple or occasionally branched, each branch terminated by a sporangium which is large, spherical, many-spored with an evanescent sporangial wall neither cutinized nor incrusted; columella always present, variable in shape; sporangiospores spherical to ellipsoid, with a thin, smooth wall; zygospores borne on the mycelium, suspensors lacking outgrowths; chlamydospores present in some species terminal or intercalary, smooth, hyaline; oidia accompanied by fermentation found in the submersed mycelium.

At present there is little conclusive evidence that this typically saprophytic genus is pathogenic for man. Most of the cases originally attributed to this genus were based on misidentification of the organism and belong elsewhere. For descriptions of species of this genus see the systematic accounts of A. Fischer (1892), Lendner (1908), and Povah (1917).

Mucor Mucedo L., Species Plantarum 1185, 1753.

The case of Fürbringer (1876) should probably be referred to *Absidia corymbifera*.

Mucor racemosus Fresenius, Beitr. z. Mycol. 12, 1850.

Pleurocystis Fresenii Bonorden, Handb. Allgem. Mykol. 124, 1851.

? Mucor scarlatinosus Hallier, Zeitschr. f. Parasitenk. **1**: 117-184, 290-352, *Pls. 3, 4,* 1869.

Chlamydomucor racemosus Brefeld, Unters. Gesammtegebiet der Mykol. **8**: 223, 1890.

Mucor scarlatinosus Hallier, a very poorly described organism was supposed to have been isolated from a case of scarlatina. It was quite probably a contamination and has been referred here as a possible synonym by A. Fischer, 1892. *M. racemosus* was reported by Bollinger (1880) from the respiratory tract of birds but was not pathogenic for laboratory animals, by Zurn (1876) in the nasal cavity of a sheep, and by Frank (1890) in a tumor in a horse, but both determinations doubtful. Savouré (1906) reports that it was not pathogenic for rabbits.

Mucor pusillus Lindt, Arch. f. exp. Path. u Pharm. **21**: 272. *Pl. 2, Figs. 1-6,* 1886. [Saprophyte.]

M. ramosus Jakowski, Gazetta Lekarska No. **34**: 1888. [Centralbl. Bakt. II, **5**: 388, 1889] not Lindt, l.c., p. 275.

The fungus reported by Jakowski from the outer ear has been referred here by Vuillemin (1904), while the original author and Barthelat (1903) refer it to *Absidia ramosa* (Lindt) Lendner.

Since there is so little conclusive evidence of pathogenicity, the reader is referred to the systematic accounts of A. Fischer 1892, Lendner 1908, and Povah 1917 for aid in determining cultures.

ABSIDIA

Absidia Tieghem, Ann. Sci. Nat. Bot. VI, **4**: 350, 1876.

Lichtheimia Vuillemin, Bull. Soc. Myc. France **19**: 119-127, 1903.

Type: *Absidia capillata* Tieghem.

Vuillemin (1903) divided this genus into six genera of which *Lichtheimia* contained the parasitic fungi so far described. The characters on which the separation was based seem comparatively trivial, and this segregation has not been followed by systematists of the group, although recognized by some medical men.

Mycelium forming stolons, often branched, more or less curved producing rhizoids more or less branched at the surface of the substratum; sporangiophores erect, usually in groups of 2-5 arising from the curved part of the stolon, not from the place of origin of the rhizoids; sporangia pyriform, erect, with an infundibuliform apophysis, membrane neither cutinized nor incrusted, diffluent, leaving a small collar at the base; columella hemispheric, conic, or terminated by a single projection, continuous with the apophysis which is cutinized and of deeper color than the sporangiophore; spores small, oval usually smooth, rarely echinulate, hyaline; zygospores formed on the stolons surrounded by circinate filaments, cutinized, growing from one or both of the suspensors. This genus differs from *Rhizopus* by the development of the sporangiophores from the internodes, by the pyriform sporangia, by the columella continuous with the apophysis and by the suspensors provided with circinate filaments.

Key to Pathogenic Species

- Growth good at ordinary temperature
    - Spores mostly spherical, 3-4μ in diameter; columella usually somewhat spinescent *A. corymbifera*
    - Spores elongate or oval, 4-5 × 2-3μ; columella smooth *A. ramosa*
- Growth poor at ordinary temperature, optimum about 37° C.
    - Sporangia 36-70μ, columella 60μ, spores ovoid 4 × 2-3μ; some growth at 51° C. *A. Truchisi*
    - Sporangia 30-38μ, columella 26μ, spores 3.2 × 3.75μ; no growth at 51° C. *A. Regnieri*

Absidia corymbifera (Cohn) Saccardo & Trotter in Saccardo, Sylloge Fungorum **23**: 825, 1912.

Mucor corymbifer Cohn in Lichtheim, Zeitschr. Klin. Med. **7**: 147, *Pls. 6-8,* 1884; Barthelat, Ann. Parasitol. **7**: 25-30, 1904.

Lichtheimia corymbifera Vuillemin, C. R., Acad. Sci. Paris **136**: 516, 1903.

Mucor corymbifera var. *typica Lichtheimi* Lucet & Costantin, Arch. de Parasitol. **4**: 380, 1901.

Absidia Lichtheimi Lendner, Mat. Fl. Cryptog. Suisse **3**: 143, 144, 1908.

Many cases in the literature dealing with bronchomycosis (Paltauf 1885, etc.). Lang & Grubauer (1923) discuss the clinical and pathologic aspects fully and summarize earlier cases. This fungus has also been reported from the ear by Huckel 1884, Siebenmann 1889, and Graham 1890.

Mycelium white, then clear gray, completely covering the substrate; hyphae often up to 15μ in diameter, branched, hyaline under microscope. Sporangiophores resupinate, branching as a corymb, terminated by sporangia, occasionally a few small sporangia on short pedicels. Sporangia hyaline, pyriform up to 70μ in diameter with mean 45-60μ, small sporangia 10-20μ, wall hyaline, smooth, diffluent, often with a basal collar; columella hemispheric, 10-20μ, smooth or sometimes papillate, smoke-gray or brownish continuous with the infundibuliform apophysis, spores nearly spherical 2-4μ, smooth, hyaline, occasionally up to 6μ.

Growth has been reported good on moist bread, potato, carrot, sugar media with slightly acid reaction, and Sabouraud agar; growth poor in liquid media; unfavorable conditions of humidity or lack of oxygen cause abundant production of gemmae; growth possible at 12-15°, optimum 36°, killed at 55° C.

Absidia italiana (Costantin & Perin) Dodge, comb. nov.

Lichtheimia italiana Costantin & Perin. Bull. Soc. Med. Chir. di Pavia **35**: 1922.

Lichtheimia italica Pollacci & Nannizzi I miceti patogeni dell'uomo e degli animali **3**: No. 26, 1924; Perin, Arch. di Clin. e Patol. Med. **2**: 5, Oct., 1923; Trattato Micopatol. Umana **1**: 55-73, 1925.

I have been unable to locate any of the original descriptions of this organism. Some have reduced it to synonymy with *A. corymbifera.* The following notes are based on Perin (1925).

Isolated from sputum and from tissue fragments from the lungs. Pathogenic for laboratory animals.

Sporangiophores branched, lacking septa, primary axes resupinate, secondary fertile axes erect with only two or three branches; rhizoids variable. Sporangia up to 66 × 58μ, columella 45μ broad, varying from hemispheric to conic, pedicel 20μ in diameter. Spores slightly ovoid, 3.2-4.2 × 2-2.8μ.

Colony on agar, white, cottony, gradually becoming grayish and finally brownish. Gelatin slowly liquefied. On liquid media, small flocci in the depths, a cottony pellicle above. Milk coagulated and acidified.

Absidia ramosa (Lindt) Lendner, Mat. Fl. Cryptog. Suisse **3**: 144-146, 1908.

Mucor ramosus Lindt, Archiv. f. exp. Path. & Pharmakol. **21**: 269, 1886.

Lichtheimia ramosa Vuillemin, Arch. de Parasitol. **8**: 562-572, Figs. 1-4, 1904.

Not *Mucor ramosus* Bulliard which is a synonym of *M. aspergillus* Scopoli transferred by Link 1824 to *Sporodinia.* Perhaps not the organism of Jakowski (1888) which may be *M. pusillus* Lindt fide Vuillemin.

Reported by Jakowski (1888) in human ear. Originally isolated on damp bread, found pathogenic to laboratory animals, and reported by Vuillemin from lesions and mucus of the nose in horses, also adenitis of lower jaw. Found in generalized infection in swine by M. Christiansen (1922) and in cases of abortion in cows by Bendixen & Plum (1929).

Sporangiophores branched as in *A. Corymbifera,* usually lacking crosswalls. Primary axes resupinate like stolons, but not recurved. Fertile axes little branched, with fewer umbels, especially compound umbels, than in *A. corymbifera.* Primary axes bear rhizoids frequently instead of terminal sporangia. Rhizoids variable. Sporangia much as in *A. corymbifera,* the diffluent membrane covered with fine granulations. Spores elongate, oval, or subcylindric, 4.8 × 2.8μ (4.6 × 2.6, 5.2 × 3μ) brownish yellow. Columella very rarely conic, mostly ovoid, not spinescent, 57.5 × 4μ where it separates from the apophysis, 35μ in maximum diameter; blue, darkening with age.

Distinguished from *A. corymbifera* by nonspinescent columella and subcylindric spores. Near *A. dubia,* intermediate between the subgenera *Lichtheimia* and *Tieghemella.*

Var. **Rasti** Lendner, Mat. Fl. Cryptog. Suisse **3**: 146, 1908.

Rising 1 cm. at the most above the substrate, mycelium constantly bluish gray, sporangia more abundant, present everywhere, larger, spores slightly more elliptic, often abnormal in shape.

Var. **Zurcheri** Lendner, Mat. Fl. Cryptog. Suisse **3**: 146, 1908.

Rising to 4 cm. above the substrate, mycelium pure white, culture less vigorous, sporangia formed only at the surface, the deeper filaments remaining pure white, spores not abnormal in shape. Both varieties grow well on potato at 45° C.

Absidia Regnieri (Lucet & Costantin) Lendner, Mat. Fl. Cryptog. Suisse **3**: 146, 147, 1908.

Mucor Regnieri Lucet & Costantin, Arch. de Parasitol. **4**: 362-384, 1901; Barthelat, Ann. Parasitol. **7**: 34, 35, 1904.

Lichtheimia Regnieri Vuillemin, C. R. Acad. Sci. (Paris) **136**: 516, 1903.

Isolated from another stable with an environment similar to that of *A. Truchisi,* pathogenic for rabbit.

Mycelium lax, weak vegetative growth, of a uniform color of gray slightly tinged with blue. Sporangiophores in corymb or umbel, the outer rays longer, unequal, swollen below the sporangium so that the collar seems to divide the columella into two parts, 3-8μ in diameter, sometimes up to 12.5 or even 19μ. Sporangial membrane smooth and transparent leaves little trace of a collar. Columella ovoid, pyriform, with a clear, brown color which extends a certain distance down the sporangiophore, frequently small 11.7μ, sometimes 23μ and rarely up to 35μ. Spores usually round, mean 3.2 to 3.75, some 2.5μ. Besides the typical spores some are avoid (3.8 × 5, 3.2 × 2.9μ) some are irregular to almost polyhedral. Zygospores unknown.

The above characters were obtained at 25° C. on solid media. Below 20° growth normal, sporangia abundant, becoming 30-38μ and pedicels 3.8 to 6.5μ. At 51-52°, slight or no growth; pedicels simple, sporangia 19μ, spores few. Killed at 55-56°.

Absidia Truchisi (Lucet & Costantin) Lendner, Mat. Fl. Cryptog. Suisse **3**: 146, 1908.

Mucor Truchisi, Lucet & Costantin, Arch. de Parasitol. **4**: 362-384, 1901. Barthelat, *Ibid.* **7**: 31-34, 1904.

Mucor corymbifer Cohn, var. *Truchisi* Sartory, Champ. Paras. Homme Anim. 91, 1921.

Isolated from a horse infected with *Trichophyton minimum.* Pathogenic for rabbits.

Mycelium lax and in general vigorous, whitish or very light gray, becoming darker in old cultures on solid media. Sporangiophores in corymbs or in an umbel with branches of unequal length, the outer usually longer, swollen below the sporangium so that the collar seems to divide the columella into two parts, 2-7μ thick, secondary axes 55-195μ; sporangia spherical with translucent membrane, smooth, about 35μ in diameter, spores regularly ovoid to slightly elongate, mean 4 × 2.5μ, smaller 3.75 × 2.5μ, and larger 4.5 × 3μ. Columella pyriform, brown at the base, becoming lighter toward the apex; mean breadth 20-26μ, smaller 4-15, larger 30μ. Zygospores unknown. At low temperature, 10-18°, mycelium little developed, fine and delicate; fructification little developed, pedicels always simple, sporangia up to 70μ, and sporangiophores 14μ in diameter. At 51-52° C. for 5 days, growth rich, fruiting abundant. Sporangia 26μ, columella 17-19μ, pedicels 5-6μ, spores 5 × 2.5-3μ. At 53° for 17 days growth still noticeable; killed at 55-56°. Growth very good on raw potato.

Absidia cornealis (V. Cavara & Saccardo) Dodge, n. comb.

Mucor cornealis V. Cavara & Saccardo in V. Cavara, Ann. di Ottalmol. **42**: 650-674, *1 pl.,* 1913.

Producing lesions in the cornea, Italy.

Mycelium loosely interwoven, white, cinereous-plumbeous on milk, bread, and potato; growth abundant at 37° C., very slow at 15° C., and at 51° C.; sterile hyphae large, branched, 14-15μ in diameter, hyaline, corymbose or racemose branched at the tips; branches of sporangiophores either alternate or opposite, simple or dichotomous, 80-300 × 7-8μ, leaving the main axis at about an angle of 45° slightly enlarged at the tips; sporangia spheric or subspheric with a thin membrane 40-44μ in diameter (rarely up to 50-55μ or as small as 15-22μ), columella obovate, pyriform, more or less light fuscous, 22-24μ broad; spores thin-walled, hyaline becoming light yellowish, spherical, 4-4.5μ, rarely ovoid, zygospores unknown.

RHIZOPUS

Rhizopus Ehrenberg, Nova Acta Acad. Leopold. **10**: 198, 1820.

Rhizomucor Lucet & Costantin, Rev. Gén. Bot. **12**: 81, 1900.

The type species is *Rhizopus nigricans* Ehrenberg. The type of *Rhizomucor* is *R. parasiticus* Lucet & Costantin.

Aerial mycelium of creeping stolons, with holdfasts at the nodes which attach the hyphae to the substrate. Sporangiophores arising in groups at the nodes, sometimes solitary, enlarged above into a columella, as in *Absidia*. Sporangia white at first, becoming black; spherical or nearly so with base slightly flattened; membrane not cuticular, uniformly incrusted and entirely diffluent without leaving a basal collar. Columella hemispheric, often flattening after dehiscence, suggesting the pileus of a mushroom. Spores spherical or ovoid, even angular, hyaline or brownish, cuticular walls, smooth or striate, rarely spinulose. Zygospores without covering from outgrowth of suspensors, forming in the substrate and on the stolons. Suspensors straight, swollen, without appendages.

Key to Pathogenic Species

Spores irregular, angular, subspheric, oval.	*R. parasiticus.*
Spores spherical, smooth or echinulate, but not angular.	
Columella conic or subcylindric (black tongue).	*R. niger.*
Columella ovoid or pyriform, pathogenic for rabbit.	
Chlamydospores not produced.	*R. rhizopodiformis.*
Chlamydospores present.	*R. equinus.*

Rhizopus equinus Costantin & Lucet, Bull. Soc. Myc. France **19**: 200, 1903.

Isolated from a horse, pathogenic for rabbit. Found in generalized infection in swine by M. Christiansen (1922) and in bovine fetal membranes and fetus by Theobald Smith (1920) who referred his species to *R. rhizopodiformis*.

Mycelium at first white, then gray after the formation of sporangia. Sporangiophores at first isolated and without rhizoids, straight or curved, later in bouquets, frequently provided with rhizoids, cutinized, pale ochraceous; 50-220μ sometimes up to 600μ long, 3-12.3μ in diameter. Sporangia 30-115μ in diameter. Columella 45-51 × 31-41μ. Spores round, sometimes slightly angular, smooth, 4μ. Chlamydospores citriform, 30 × 25 or 40 × 26μ, or spherical, 20μ in diameter, forming ordinarily on the mycelium. Zygospores unknown.

Var. **annamensis**, P. N. Bernard, Bull. Soc. Myc. France **30**: 230-232, *Pl. 14,* 1914; Bull. Soc. Path. Exot. **7**: 430, 1914.

Isolated from sputum of an Annamite, aged thirty-two, 32 in 1911; sputum blackish, as if mixed with carbon grains. Cough with a little dyspnea. Whole left lung infected. No previous history except bronchitis, with complete recovery. Hospitalized for cough in fall, 1910, worse July, 1911, but alive in December, disease seemingly arrested and localized. Intravenous inoculations in pigeons, no effect; nor intraperitoneal, in guinea pig; rabbit succumbed by both methods, but not by subcutaneous inoculation. Organism recovered.

Isolated sporangiophores without rhizoids 72-450μ × 8-12μ usually 150 × 12μ. Sporangiophores in pairs near each other, pedicels short 78-210 × 8 – 12μ, 30-45μ between pedicels, without rhizoids. Sporangiophores with rhizoids singly or in pairs, the latter 138-144 × 8-9μ, occasionally pedicels up to 420-780μ long. Sporangia oblate spheroid, 48-84μ. Columella 18-48μ high × 24-52μ broad. Cutinization from pedicels to rhizoids and stolons, less accentuated on the columella. No collar after sporangial dehiscence. Intercalary chlamydospores 36 × 24μ citriform; or spherical 30-42μ in diameter; ovoid 60 × 48-42 × 30μ, numerous even in aerial portions. Spores round, smooth, 4μ, not cutinized.

Growth good on Sabouraud agar for several months, then suddenly stopped fruiting on carrot and potato glucose; optimum 37-39° C., tube filled with mycelium in 3-4 days; sporangia in 5 days; no growth at 5° C.; killed at 100° moist heat in 15-20 minutes.

Rhizopus niger (Ciaglinski & Hewelke) Barthelat, Mucorinées pathogènes et les Mucormycoses 55, 56, 1903; Arch. de Parasitol. **7**: 46, 47, 1903.

Mucor niger Ciaglinski & Hewelke, Zeitschr. Klin. Med. **22**: 626, 1893.

Isolated in cases of black tongue; not pathogenic for guinea pigs or rabbits. Also found later by Sendziak (1894).

Stolons provided with numerous rhizoids, forming a snow-white layer. Sporangiophores erect, straight, fasciculate, terminated by spherical sporangia, which become black at maturity. Columella at first cylindric 2-3 times as long as wide, later enlarging and becoming hemispheric; after the dehiscence of the sporangium assuming the appearance of an open umbrella. Spores oval, smooth, gray, black in mass. Growth good on potato and in bread gelatin, optimum 25-27° C., growth ceases at 37° C.

Rhizopus parasiticus (Lucet & Costantin) Lendner, Mat. Fl. Cryptog. Suisse **3**: 115, 1908.

Rhizomucor parasiticus Lucet & Costantin, Rev. Gén. Bot. **12**: 81, *Pl. 3,* 1900; Arch. de Parasitol. **4**: 384-408, 1901. [See p. 394.]

Mycosis of lung of country woman, final recovery after several months of treatment with arsenic. See Arch. de Parasitol. **4**: 386-389, 1901, for case history and results of inoculations. Nonpathogenic in subcutaneous inoculations.

Mycelium gray (lead color) to mouse gray then grayish brown to yellow. Stolons and rhizoids irregular. Sporangiophores branched in simple clusters, or in corymbs 12-14μ in diameter, 1-2 cm. long; sporangia 35-80μ, with membrane covered with fine crystalline needles; columella ovoid, pyriform, cutinized slightly brownish, 30-70μ long by 24-56μ in diameter; lateral sporangia similar but much smaller; pedicels rarely ramifying a second time; spores irregular or reniform, smooth, 4 × 2.5μ. Zygospores unknown.

Growth on most media very good, but less on peptone broth and on very acid or alkaline media, poor on coagulated sera, amniotic liquid, white of egg, cider, apples, or pears, the latter, however, is good if glycerin or glucose is added. Growth more rapid on solid than on liquid media. [Very full description given in Arch. de Parasitol. **4**: 384-408, 1901.]

Optimum about 37° C.; growth starts at 22°, at 51-52° very abnormal vegetative growth but no spores. It needs much oxygen.

Rhizopus rhizopodiformis (Cohn) Zopf, Die Pilze 317, 1890.

Mucor rhizopodiformis Cohn in Lichtheim, Zeitschr. Klin. Med. **7**: 148, 1884.

Rhizopus Cohnii Berlese & de Toni in Saccardo, Syll. Fung. **7**: 213, 1888.

Pathogenic for the rabbit when injected into peritoneum and veins. Ziegenhorn (1886) was unable to modify pathogenicity of spores. T. Smith (1920) reports this organism on membranes and in lungs and digestive tracts of fetus but probably it was *R. equinus*.

Mycelium white, then mouse-gray, rising as a spider web above the substrate. Stolons forming rhizoids at point of contact with substrate, in brownish bouquets. Sporangiophores isolated or grouped, erect or incurved, short, 120-125μ, not branched, with brownish membrane enlarging in an apophysis. Sporangia spherical, 60-110μ usually about 66μ, blackish at maturity, smooth with incrusted membranes. Columella forming with the apophysis an ovoid or pyriform organ, 50-75μ broad, membrane smooth and brownish. Spores usually spherical, small, 5-6μ, without angles, smooth, hyaline. Zygospores and chlamydospores unknown.

Cultural characters are similar to those of *Absidia corymbifera* (p. 112). Optimum temperature 37-38° C., sporangia after 48 hours, mycelium changing from white to gray. At 12-15° spores germinate on third day, sporangia on fourth or fifth day. At 45° the mycelium is arrested and spores are killed at 68°.

Doubtful Position

Rhizomucor septatus (Bezold in Siebenmann) Lucet & Costantin, Arch. de Parasitol. **4**: 362, 1901; Barthelat, Mucorinées pathogènes et les mucormycoses 52, 1903.

Mucor septatus Bezold in Siebenmann, Die Schimmelmycosen 97. Wiesbaden, 1889.

Mycelium colorless, sporangiophores brown, in branching cluster, sometimes terminating in an umbel, with small rhizoids at the base with a mean diameter of 10μ; secondary pedicels, 3-4 in number, are short with crosswalls at point of branching; sporangia pale grayish brown, spherical, transparent membrane, smooth or slightly papillate, 32μ in diameter; columella also brown, spherical or slightly ovoid, mean diameter of 27μ; spores spherical or ovoid, smooth, clear yellowish or brownish, 2.5 – 4μ.

Referred to *Mucor racemosus* by A. Fischer, and Lendner. It also resembles *M. bifidus* Fresenius. It differs from *R. parasiticus* in smooth sporangial wall devoid of crystals, sporangia smaller, and sporangiophores always septate.

MORTIERELLA

Mortierella Coemans, Bull. Acad. Sci. Belgique II, **15**: 536, 1863.

The type species is *Mortierella polycephala* Coemans.

Mycelium within the substrate or forming a closely appressed weft over its surface, not typically aerial; sporangiophores erect, simple or branched, usually tapering to a delicate tip just below the sporangium, often swollen below; sporangia spherical without columella, wall soon disappearing; stylospores unicellular, spherical, echinulate, suggesting sporangia with a single spore; zygospores enveloped by a thick layer of densely woven hyphae which arise just below the gametangia and tend to obscure the details of conjugation.

Mortierella niveovelutina Ciferri & Ashford, Porto Rico Jour. Publ. Health & Trop. Med. **5**: 134-143, *1 pl.*, 1929.

Isolated from a Porto Rican with a patch of inflamed papules covering the antero-external aspect of the right thigh and extending around behind, ending below at the insertion of the adductor muscles. At first glance the appearance reminded one of psoriasis, but when fading, the eruption became discrete and parts once thickly studded with red nodules disappeared without leaving a trace of the former thickly infiltrated red nodular area. Intense pruritus present. Healed by the application of salicylic acid, ichthyol, and sulphur ointment.

Colony white, velvety; mycelium of highly branched hyaline hyphae with apical branches normally bifurcate, occasionally with three forks, continuous or later scantily septate, with frequent and complex anastomoses, without rhizoids, 2-3μ in diameter; hypnospores in chains in liquid media, less abundant in solid media, from spherical to elongate with a smooth membrane; stylospores or aerial hypnospores normally very abundant, singly or in chains of up to 12 cells, generally 2-3μ in diameter with a smooth epispore; sporangiophores 30-80μ long, straight erect, of uniform diameter, never branched, containing an apical septum immediately beneath the sporangium; a single sporangium for each sporangiophore, approximately spherical, 30-90μ in diameter normally about 60μ, irregularly dehiscent with smooth, diffluent membrane, in part more or less firmly fixed in the sporangiophore; numerous spores in each sporangiophore (15-20 or more) elliptico-apiculate, with the extremities more or less pointed, 3.0-3.5 × 4-4.5μ, producing one or two germ tubes, simple then repeatedly dichotomous; zygospores not seen. Ferments glucose feebly; assimilates well the monohexoses, peptone and ammonium sulphate.

Growth good on bread and liquid media, such as Raulin's fluid, Difco malt extract, and Lendner's dealcoholized white wine agar. Growth slow on many other media reported.

Mortierella sp. Costantin, Bull. Soc. Myc. France **8**: 57-59, 1892.

Isolated from a cat. Too poorly described for identification.

BIBLIOGRAPHY

Barthelat, G. J. 1903. Les mucorinées pathogènes et les mucormycoses, *Thèse de Paris.* 127 pp., *13 figs.; Arch. de Parasitol.* 7: 1-116, *13 figs.*

Bernard, P. Noel. 1914. Sur un Rhizopus pathogène de l'homme: Rhizopus equinus Lucet & Costantin var. annamensis, *Bull. Soc. Path. Exot.* 7: 430-437.

—. 1914. Sur un Rhizopus pathogène de l'homme, *Bull. Soc. Myc. France* 30: 230-232, *Pl. 14.*

Bodin, Eugène & Pierre Savouré. 1904. Recherches expérimentales sur les mycoses internes, *Arch. de Parasitol.* 8: 110-136.

Casagrandi, Carmelita. 1931. Sulla presenza di Basidioboli nell'uomo, *Riv. Biol.* 13: 1-8, *1 fig.* Also *Boll. Soc. Internaz. Microbiol. Sez. Ital.* 9: 63, 64.

Cavara, Vittoriano. 1913. Una forma nuova di cheratomicosi (cheratomicosi mucorina), *Ann. Ottalmol.* 42: 650-674, *1 pl.*

—. 1913. Sull'importanza patogena per l'occhio di alcune specie di Mucor, *Ann. Ottalmol.* 42: 729-771.

Christiansen, M. 1922. Mycoses généralisées chez le porc, déterminées par des mucorinées, *C. R. Soc. Biol.* 86: 461-463.

—. 1922. Generel mucormykose hos svin, *K. Veterinaer og landbohøjskole. Aarsskrift.* 1922: 132-190, *2 pls., 11 figs.*

Ciaglinski, A. & O. Hewelke. 1893. Über die sogenannte Schwarze-Zunge, *Zeitschr. Klin. Med.* 22: 626-632, *5 figs.*

Ciferri, Raffaelle & Bailey K. Ashford. 1929. A new species of Mortierella isolated from the human skin, *Porto Rico Jour. Public Health. & Trop. Med.* 5: 134-143, *1 pl.*

Cohnheim. 1865. Zwei Fälle von Mycosis der Lungen, *Arch. Path. Anat. Physiol. Klin. Med.* 33: 157.

Costantin, Julien. 1892. Note sur un cas de pneumomycose observé sur un chat par M. Neumann, *Bull. Soc. Myc. France* 8: 57-59.

Costantin, Julien & Adrien Lucet. 1903. Sur un Rhizopus pathogène, *Bull. Soc. Myc. France* 19: 200-216, *Pls. 9, 10.*

Dessy, G. 1933. La chemiothérapie des mycoses. III. Mucoromycose. II. Expériences in vivo, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 9: 201-206.

Ernst, H. C. 1918. A case of Mucor infection, *Jour. Med. Res.* 34: 143-146, *Pl. 3.*

Frank. 1890. [Aspergillus fumigatus, Mucor racemosus], *Deutsche Zeitschr. Thiermed. Vergl. Path.* 16: 296, 297.

Gasperini, Gustavo. 1927. Il dinamismo citoplasmatico nelle Mucorinee sottoposte a varie azioni e singolaramente a quelle degli elettroliti, *Ann. Ig.* 37: 193-231, *3 pls.*

Gortner, R. A. & A. F. Blakeslee. 1914. Observations on the toxin of Rhizopus nigricans, *Am. Jour. Physiol.* 35: 353-367.

Graham, Harry. 1890. Mucor corymbifer in the external auditory meatus, *Lancet* 2: 1379.

Herla, Victor. 1895. Note sur un cas de pneumomycose chez l'homme, *Bull. Acad. Roy. Méd. Belgique.* IV, 9: 1021-1031, *1 pl.*

Hückel, Armand. 1884. Zur Kenntnis der Biologie des Mucor corymbifer, *Beitr. Path. Anat. Allg. Path.* 1: 115-131, *Pl. 3.*

Korte, W. E. de. 1923. A paramycetoma (?) of the forearm, *Jour. Path. Bact.* 26: 189-192.

Lang, F. J. & F. Grubauer. 1923. Über Mucor- und Aspergillusmykose der Lunge, *Arch. Path. Anat. Phys.* [Virchow] 245: 480-512, *17 figs.*

Leinati, Fausto. 1928. Micosi rare in animali. Osservazioni cliniche sperimentali, *Atti R. Accad. Fisiocrit. Siena* X, 3: 83-92, *3 pls.*

—. 1929. Ulcere micotiche sperimentali dello stomaco, *Atti R. Accad. Fisiocrit. Siena* X, 4: 147-223, *23 figs.*

Lichtheim, L. 1884. Über pathogene Mucorineen und die durch sie erzeugten Mykose des Kaninchens, *Zeitschr. Klin. Med.* 7: 140-177.

Lindt, Wilhelm. 1886. Mittheilungen über einige neue pathogene Schimmelpilze, *Arch. Exp. Path. Pharm.* 21: 269-298.

Lucet, Adrien & Julien Costantin. 1899. Sur une nouvelle Mucorinée pathogène, *C. R. Acad. Sci.* 129: 1031-1034.

—. 1900. Rhizomucor parasiticus, espèce pathogène de l'homme, *Rev. Gén. Bot.* 12: 81-98, *Pl. 3.*

—. 1901. Contribution à l'étude des mucorinées pathogènes, *Arch. de Parasitol.* 4: 362-408.

Macfarlan, Douglas. 1924. Fungus of the tongue, *Laryngoscope* 34: 720-722.

Martins, César. 1928. Mycose pulmonaire à Rhizomucor parasiticus, *C. R. Soc. Biol.* 99: 957, 958.

Motta, Roberto. 1926. Contributo allo studio delle micosi del condotte uditivo esterno (Studio clinico e micologico), *Atti R. Accad. Fisiocrit. Siena.* IX, 17: 603-631, *9 figs.*

Paltauf, Arnold. 1885. Mycosis mucorina. Ein Beitrag zur Kenntnis der menschlichen Fadenpilzerkrankungen, *Arch. Path. Anat. Physiol.* [Virchow] 102: 543-565, *Pl. 6.*

Parisot, Jacques & Pierre Simonin. 1922. Mycose pulmonaire associée; réactions biologiques et recherches expérimentales, *Rev. Méd. de l-Est.* 50: 8-11.

Peña Chavarría, Antonio & Janet H. Clark. 1924. The reaction of pathogenic fungi to ultraviolet light and the rôle played by pigment in this reaction, *Am. Jour. Hyg.* 4: 639-649, *6 figs.*

Podack, Max. 1899. Zur Kenntnis des sogenannten Endothelkrebs der Pleura und der Mucormykosen, *Deutsch. Arch. Klin. Med.* 63: 1-73.

Redaelli, Piero. 1924. Contributo sperimentale allo studio della Moniliasi e della Lichtheimiasi, *Rif. Med.* 40: 665, 666.

Savouré, Pierre. 1905. Recherches expérimentales sur les mycoses internes et leurs parasites, *Arch. de Parasitol.* 10: 5-70.

Sendziak, Johann. 1894. Beitrag zur Aetiologie der sogenannten schwarzen Zunge, *Monatschr. Ohrenheilk. Kehlkopf-, Nasen- u. Rachenkrankh.* 28: 112-119, 228.

Smith, Theobald. 1920. Mycosis of the bovine fetal membranes due to a mould of the genus Mucor, *Jour. Exp. Med.* 31: 115-122, *1 fig.*

Spillmann, L. & Ph. Lasseur. 1922. Un cas d'épidermomycose, *Congr. Derm. Syphiligr. Langue Franç.* 1: 42, 43.

*Stange, G. 1892. Experimenteller Beitrag zur Pathogenität der Mucorineen, *Inaug. Diss. Dorpat.*

Vuillemin, Paul. 1903. La série des absidiées, *C. R. Acad. Sci.* 136: 514-516.

—. 1904. La Lichtheimia ramosa (Mucor ramosa Lindt) champignon pathogène distinct du L. cormybifera, *Arch. de Parasitol.* 8: 562-672, *Figs. 1-4.*

Ziegenhorn, Otto. 1886. Versuche über Abschwachung pathogenen Schimmelpilze, *Arch. Exp. Path. Pharm.* 21: 249-268.

CHAPTER VIII

ASCOMYCETES

The Ascomycetes are those fungi in which meiosis occurs in characteristic sporangia with endogenous spore formation. These sporangia are called **asci** and their spores, **ascospores.** Their thallus is generally well developed; its hyphae (in contrast to those of the Phycomycetes) are regularly divided by septa into uni-, bi- or, rarely, multinucleate cells. Under certain environmental conditions, they may continue growth by sprouting; in the yeasts and a few other forms, only the sprout mycelium is known.

The imperfect forms reach the culmination of development in this group, especially among the pathogens of the higher plants. Besides oidia, hypnospores, etc., the most varied types of conidia are found, often produced in highly specialized organs which at times approach the perfect (sexual) forms in complexity. In certain families, several imperfect forms may be produced successively or even simultaneously in the same species, a condition usually referred to as **polymorphism.** In case the perfect stage is unknown, these imperfect stages are given a name and classified among the **Fungi Imperfecti.**

The sexual organs of the primitive groups with which we are concerned more or less resemble those of the Phycomycetes, especially those of the Mucorales. In the most primitive family we have gametes differentiated and set free to copulate in pairs. These produce a diploid ascogenous hypha. These conditions approximate those in the Oomycetes, although the ascogenous hypha and ascus seem to be a new development. Also in the Ascoideaceae we have a proliferation of the gametangium or ascus which is suggestive of the Oomycetes. Aside from these very primitive forms there are simple isogamous or heterogamous copulation branches very much as we found in the Mucorales.

In the higher groups, there is an extensive functional and morphologic differentiation, the male being differentiated as an **antheridium** and the female as an **ascogonium.** A unicellular antheridium approaches a unicellular ascogonium and is surrounded by the filamentous end of the ascogonium, known as the **trichogyne.** In the Plectascales, the only group of interest to medical men, there is not a great differentiation of trichogyne from the ascogonium.

In most groups plasmogamy has lost its obligatory character and becomes facultative. Morphologically this functional disturbance first affects only the antheridia; these disappear and amphimictic fertilization is replaced by many deuterogamous processes. (For details, see Gäumann & Dodge 1928.) Gradually this functional degeneration extends to the female organs which also disappear in many groups. Eventually no sexual organ is formed and plasmogamy becomes pseudogamous.

In conjunction with this degeneration, there is a shifting in the significance of the sexual organs for the formation of fructifications. In the lower groups the fructification is initiated by the formation of the sexual organs. In many of the higher forms, external stimuli cause the fructifications to develop independent of sexual organs which are later formed within the fructification.

Plasmogamy is not followed directly by caryogamy but one or several dicaryons are formed. In the lower forms, the dicaryon migrates directly into an ascus which is the product of the plasmogamy. In the higher forms, plasmogamy is increasingly retarded and the fertilized gametangium develops into one or more hyphae. These take up the dicaryon and by conjugate division, branch and form asci. Such dicaryotic hyphae are therefore called **ascogenous hyphae**; biologically they offer the advantage that one gametangium can create a number of asci.

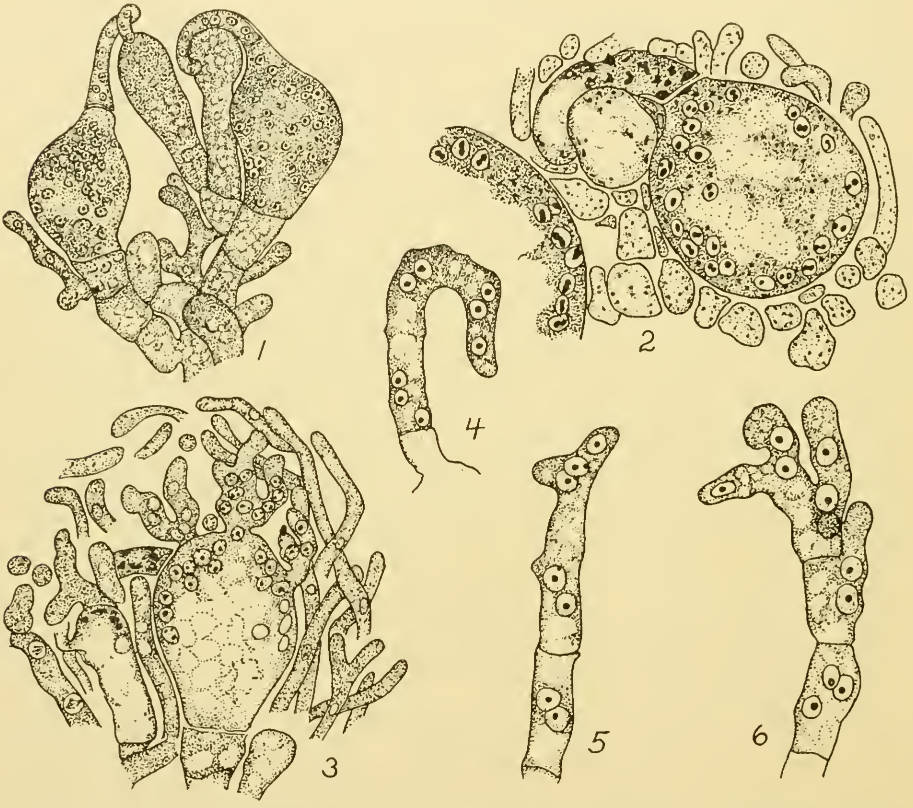

Fig. 11.—*Pyronema confluens.* *1,* Two antheridia arising from a dichotomous hypha, a trichogyne is in contact with each. *2,* An ascogonium showing fusion in pairs of the sexual nuclei. *3,* An older stage, showing the beginning of ascogenous hyphae. *4,* Young ascogenous hypha. *5,* An older hypha in which wall formation is in progress. *6,* Older hyphae in which the binucleate cells are building out to form croziers. (*1* and *3* ×660, *2* ×1,060, *4-6* ×1,230.) (After Gwynne Vaughan & Williamson 1931.)

In most of the higher Ascomycetes, the asci develop from croziers at the end of the ascogenous hyphae. Each of the ascogenous hyphae arising from the ascogonium contains a number of dicaryons and develops by repeated forking, more or less vertically toward the top of the future fructification

(Fig. 11, *3*). Subsequently it divides by septa so that in the vicinity of the ascogonium the cells contain 2-8 dicaryons and farther away only one (Fig. 11, *4*). A cell with only one dicaryon puts forth a lateral process whereby the nuclei are rather far separated (Fig. 11, *6*); shortly the process bends around into a crozier, and the nuclei begin to divide conjugately (Fig. 12, *1*). The spindles lie approximately parallel to each other. After the division, the crozier is abjointed from both the tip and stipe cells which contain one nucleus each (Fig. 12, *2*). In the simplest case the nuclei of the crozier fuse to a diploid nucleus, the primary ascus nucleus, and the crozier develops an ascus (Fig. 12, *3*).

In another type, the crozier develops a new crozier which in turn may develop still another. In any case it is only the terminal crozier that develops an ascus. In a third type, the dicaryon of the crozier divides without forming any new crozier. The original crozier develops a branch which later may form a new crozier whereon an scus may arise directly; or caryogamy may again be retarded with the result that a tuft of croziers is formed. Occasionally the stipe and tip of the crozier fuse, the stipe nucleus generally migrating into the tip cell. This proceeds to develop a binucleate branch which gradually forms a crozier that may develop an ascus by fusion of its nuclei or repeat crozier formation.

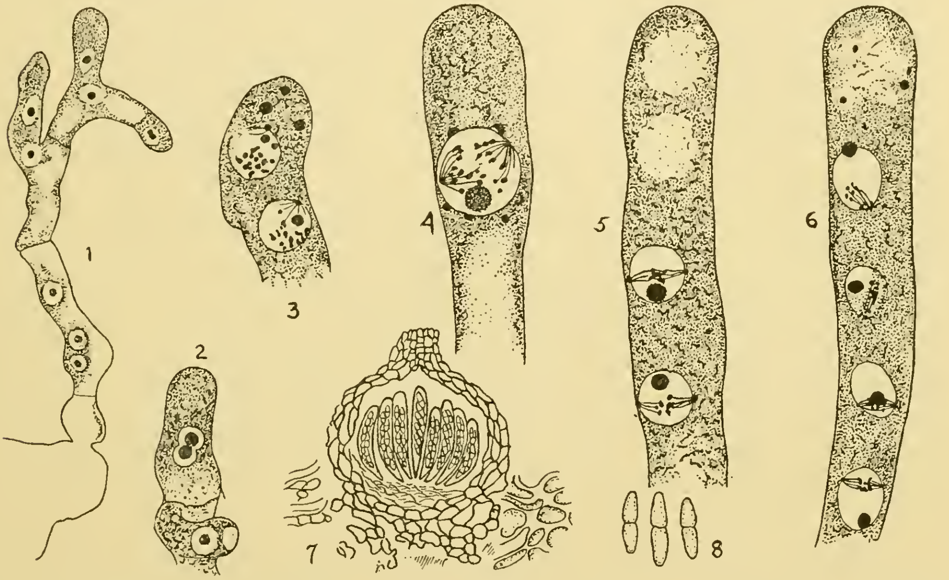

Fig. 12.—*Pyronema confluens.* *1,* Older ascogenous hypha with a new ascogenous hypha budding out to form croziers, the tip cell uninucleate. *2,* A crozier, showing fusion in the ascus cell. *3,* Prophase in the two nuclei of a crozier, each showing twelve chromosomes. *4,* First mitotic telophase in the ascus with twelve whole chromosomes going to each pole. *5,* Metaphase of the second division in the ascus, showing six chromosomes. *6,* Third division in the ascus; the lower nuclei are in the late metaphase, the next shows the anaphase, and that nearest the apex an early telophase in which six chromosomes can be counted at the pole. *7, Mycosphaerella Fragariae,* a typical perithecium. *8,* Ascospores. (*1* and *2* ×1,230; *3-6* ×1,760; *7* ×360; *8* ×800.) (After Gwynne Vaughan & Williamson, 1931 and Klebahn 1918.)

In the higher Ascomycetes, there are, in addition to the crozier type, a whole series of other developmental forms of ascogenous hyphae which need not concern us at present.

As far as is known, the further development of the asci is the same in all Ascomycetes. The primary ascus nucleus, which has arisen from the fusion of the dicaryon (Fig. 12, *3*), undergoes three divisions, at least one of which is meiosis; the eight daughter cells cut out eight ascospores from the cytoplasm of the ascus by free cell formation. The cytoplasm not included in the spores is called epiplasm, which, besides nourishing the ascospores, provides substances for the sculpturing of the spore walls. In certain forms, the number of nuclear divisions may be limited to two or may increase to sixteen, in the former case producing but 4 ascospores and in the latter 64,936. Where the ascospores are thick-walled, they usually possess a typical germ pore or a meridional fissure. In the latter case, the halves of the ascospore wall separate in germination like the two valves of a mussel.

According to the Anglo-Saxon school, represented by Harper, B. O. Dodge and Gwynne-Vaughan (née Fraser) the nuclear fusion in the young ascus is not the first and only fusion; but is preceded by another fusion in the ascogonium directly after plasmogamy. The ascogenous hyphae, according to this conception, do not contain haploid dicaryons but undivided diploid nuclei which only after the formation of the croziers come together as dicaryons. Because of this double fertilization, the primary ascus nucleus is tetraploid and contains 2x double chromosomes. At the first ascus division (Fig. 12, *4*) meiosis occurs with each daughter nucleus containing 2x simple chromosomes. The second step is homeotypic (Fig. 12, *5*), the 2x simple chromosomes are halved so that each daughter nucleus still contains 2x simple chromosomes. In the third step (brachymeiosis) (Fig. 12, *6*) one-half of the undivided chromosomes migrates to each pole, so that each daughter nucleus of the third division contains x simple chromosomes.

Although the cytologic reports are somewhat contradictory and in part may be interpreted by either hypothesis, the students of Continental Europe and some in America prefer the interpretation of Dangeard and Claussen.

First imperfect forms, then sexual organs arise on the haplont. Between these sexual organs plasmogamy occurs, while the male and female nuclei pair as a dicaryon. These dicaryons migrate into the ascogenous hyphae and divide conjugately. The ascogenous hypha thus represents a special diploid phase, the dicaryophase, which ends with caryogamy (fusion) in the young asci. Caryogamy is followed directly by meiosis, usually producing 8 haploid ascospores. In the higher Ascomycetes this scheme of development is further complicated, since the haploid thallus proceeds to form fructifications on or in which the ascogenous hyphae complete their development. As in most red algae and in the sporophyte of the mosses, the dicaryophase is to a certain extent parasitic on the haplont and nourished by it.

In the simplest case, these fructifications form an undifferentiated mass of tissue, a stroma on or in which the asci are formed. A fructification of this type is called an **ascostroma**. In the higher forms the hyphal tissue of the stroma undergoes differentiation both in form and histologic structure, and develops the fructifications which furnish important characters for classification. Only one of these structures in its simplest form need concern us here. For a further consideration of the higher Ascomycetes see Gäumann & Dodge (1928) and the recent fundamental work of Nannfeldt (1932).

The **perithecium** consists of a solid, often pseudoparenchymatous wall and a cavity in which the asci are borne (Fig. 12, *7*). The more primitive types are usually spherical; the asci lie irregularly in the interior and are only liberated by the decay of the perithecial wall. In the higher types, there are more elaborate mechanisms for spore dispersal.

BIBLIOGRAPHY

Gäumann, Ernst A. & Carroll William Dodge. 1928. Comparative morphology of fungi. New York, McGraw Hill Book Company, 701 pp., *398 figs.*

Nannfeldt, J. A. 1932. Studien über die Morphologie und Systematik der nicht-lichenisierten inoperculaten Discomyceten, *Nova Acta R. Soc. Sci. Upsaliensis* IV, 8: 2:1-368, *Pls. 1-20.*

CHAPTER IX

ENDOMYCETALES

The Endomycetales include those forms in which an ascus arises directly as the product of a sexual act, wherever this occurs. They comprise eleven families distributed among four diverging lines of degeneration. In the most primitive family, the Spermophthoraceae, the mycelium is nonseptate and coenocytic, the gametes are differentiated and freed from the gametangium, and a septate uninucleate secondary mycelium results. From this primitive family we have four diverging lines of degeneration, each line having a characteristic spore shape. In the Ashbyaceae, the mycelium, when present, may be septate, but the cells are usually coenocytic and have the elongate fusiform ascospore of the Spermophthoraceae (Fig. 13, *1-3*). In the Ascoideaceae—Endomycetaceae line, the mycelium becomes uninucleate, the ascospores, which in the early stages of its development are fusiform, become cucullate (Fig. 13, *10*), or the rim assumes an equatorial position, producing a saturnine spore (Fig. 13, *6*). The position of the Pichiaceae is not clear. Here the ascospores are hemispheric or slightly angular (Fig. 13, *7, 8*). They may possibly be derived from *Guillermondella* (Fig. 13, *9*), a member of the Ashbyaceae, or more probably *Hanseniospora,* one of the Endomycetaceae with rough cucullate spores, by the loss of the rim (Fig. 13).

In the two remaining lines, the spores are ellipsoid or spherical and have probably diverged from the Spermophthoraceae through *Dipodascus.* One line retained strong evidence of sexuality, gradually losing it with extreme degeneration, producing its spores saprophytically, and early reducing the ascospore number to 8, 4, or fewer. This line is represented by the Eremascaceae and Saccharomycetaceae. The other line promptly discarded traces of sexuality, produced its spores in the host tissue, very rarely under saprophytic conditions, and retained the large number of ascospores of the Dipodascaceae. This latter line is represented by three strictly parasitic families, one comprising predominantly mammalian parasites, the other two plant pathogens. There is a small residue of species usually placed in the Saccharomycetaceae, in which the ascospores copulate in pairs. Their systematic position is not clear. Guilliermond has recently (1931) suggested that this group of species has been derived from the Taphrinaceae, the end member of the fourth line mentioned above.

Key to Families

Gametes fusiform, set free from the gametangium, copulating in pairs, producing an ascogenous hypha; ascospores fusiform. *Spermophthoraceae.*

Gametes not set free, gametangial copulation the usual type, or the ascospores develop parthenogenetically.

Ascospores fusiform to acicular. *Ashbyaceae.*

Ascospores, cucullate, saturnine.
Mycelium multinucleate, conidia produced, ascus many-spored, proliferating. *Ascoideaceae.*
Mycelium uninucleate, degenerating to sprout mycelium; conidia not differentiated; ascospore number usually 4 or fewer; not proliferating. *Endomycetaceae.*
Ascospores hemispheric or angular; sprout mycelium uninucleate; ascospores 4 or fewer. *Pichiaceae.*
Ascospores ellipsoid or spherical.
Mycelium multinucleate, ascus resulting from copulation of two hyphal tips.
Ascus many-spored. *Dipodascaceae.*
Ascus 8- or 4-spored. *Eremascaceae.*
Mycelium uninucleate, usually sprout mycelium, asci resulting from copulation of two cells or from parthenogenesis or apogamy. *Saccharomycetaceae.*
No trace of copulation; asci many-spored, rarely reduced to 8; mycelium often scanty in the tissue but then developing readily in culture; asci usually thick-walled, often differentiated as a resting spore, usually abundant in host tissue, rare in culture.
Ascospores developing directly and filling the ascus. *Coccidioideaceae.*
Ascospores developing in tetrads about the wall of the ascus. *Protomycetaceae.*
Ascospores developing directly, but reduced in number, not filling the ascus, mycelium developing in host tissue. *Taphrinaceae.*

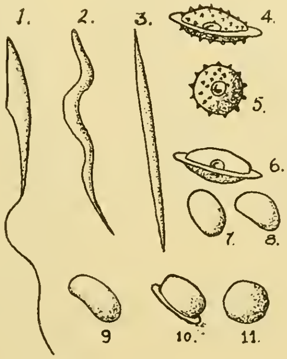

Fig. 13.—Spore shapes in the Endomycetales. *1, Nematospora; 2, Coccidiascus; 3, Monosporella; 4, Schwanniomyces; 5, Nadsonia; 6, Williopsis; 7, 8, Pichia; 9, Guilliermondella; 10, Endomyces; 11, Saccharomyces.* (After Guilliermond 1928.)

Spermophthoraceae.—In *Spermophthora Gossypii* on cotton, the mycelium is nonseptate and coenocytic. It produces gametangia with numerous fusiform gametes (Fig. 14, *1*). After the dehiscence of the gametangium, the gametes fuse in pairs, and the resulting zygote germinates immediately by a septate, uninucleate, diploid mycelium (Fig. 14, *2-7*). The asci are borne directly on this mycelium without crozier formation (Fig. 14, *8*). The ascospores are fusiform, but smaller and shorter than the gametes. The differentiation of gametes is suggestive of remote derivation from the Oomycetes rather than from the Zygomycetes or Mucorales, as suggested by Gäumann (1926). In neither group is there any structure in any way comparable to the diploid ascogenous mycelium of this family.

Ashbyaceae.—This family has been little studied cytologically. In *Piedraia Hortai,* forming hard nodules on human hair, the mycelium is thick-walled, septate, and more or less agglutinated into a solid mass surrounding the reproductive structures (Fig. 15, *1, 2, 12*). Young cells contain up to 8 nuclei, but mature cells are mostly uninucleate, although one cell figured by Horta (1911) suggests a binucleate condition. The functions of gametangium and ascus, performed by distinct structures in the Spermophthoraceae, are performed by a single structure, usually called the ascus, which arises as the terminal cell of a hypha. The gametes are differentiated within this structure but unite in pairs without being set free (Fig. 15, *3-11*). The resulting zygotes then elongate to produce the 8 uninucleate, fusiform, or crescent-shaped ascospores with 2 (rarely 3) filiform appendages (Fig. 15, *13-16*). The details of the cytology have not yet been reported. The ascospores germinate directly to mycelium which penetrates beneath the cuticle of the hair, forming a pseudoparenchymatous palisade which eventually ruptures the cuticle and expands to produce the typical nodule. In *Piedraia venezuelensis,* little is known of its life history, but the ascospore number is reduced to four and the filiform appendages practically disappear. Langeron (1929) and Brumpt & Langeron (1934) suggest that *Piedraia* is related to the sooty molds which it resembles slightly in general appearance, but in the curious development of gametes and

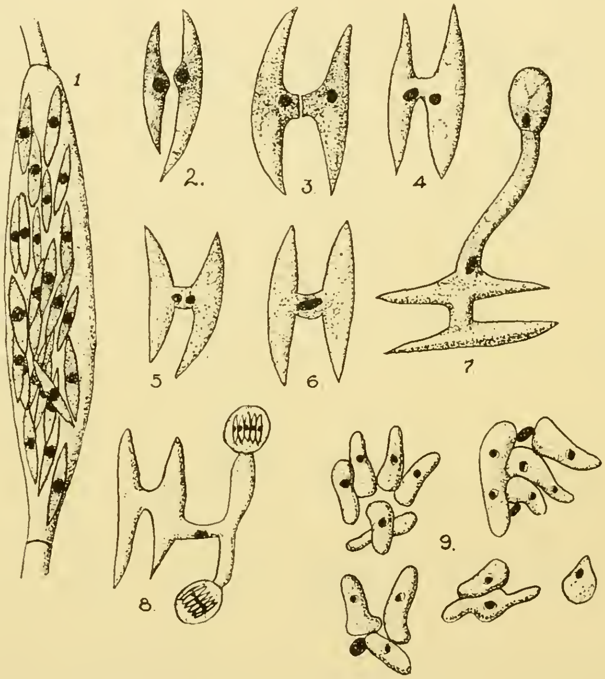

Fig. 14.—*Spermophthora Gossypii. 1,* gametangium showing immature gametes within; *2-6,* stages of copulation of gametes, ascogenous filament with young ascus; *8,* asci showing ascospores; *9,* germinating ascospores. (After Guilliermond 1928.)

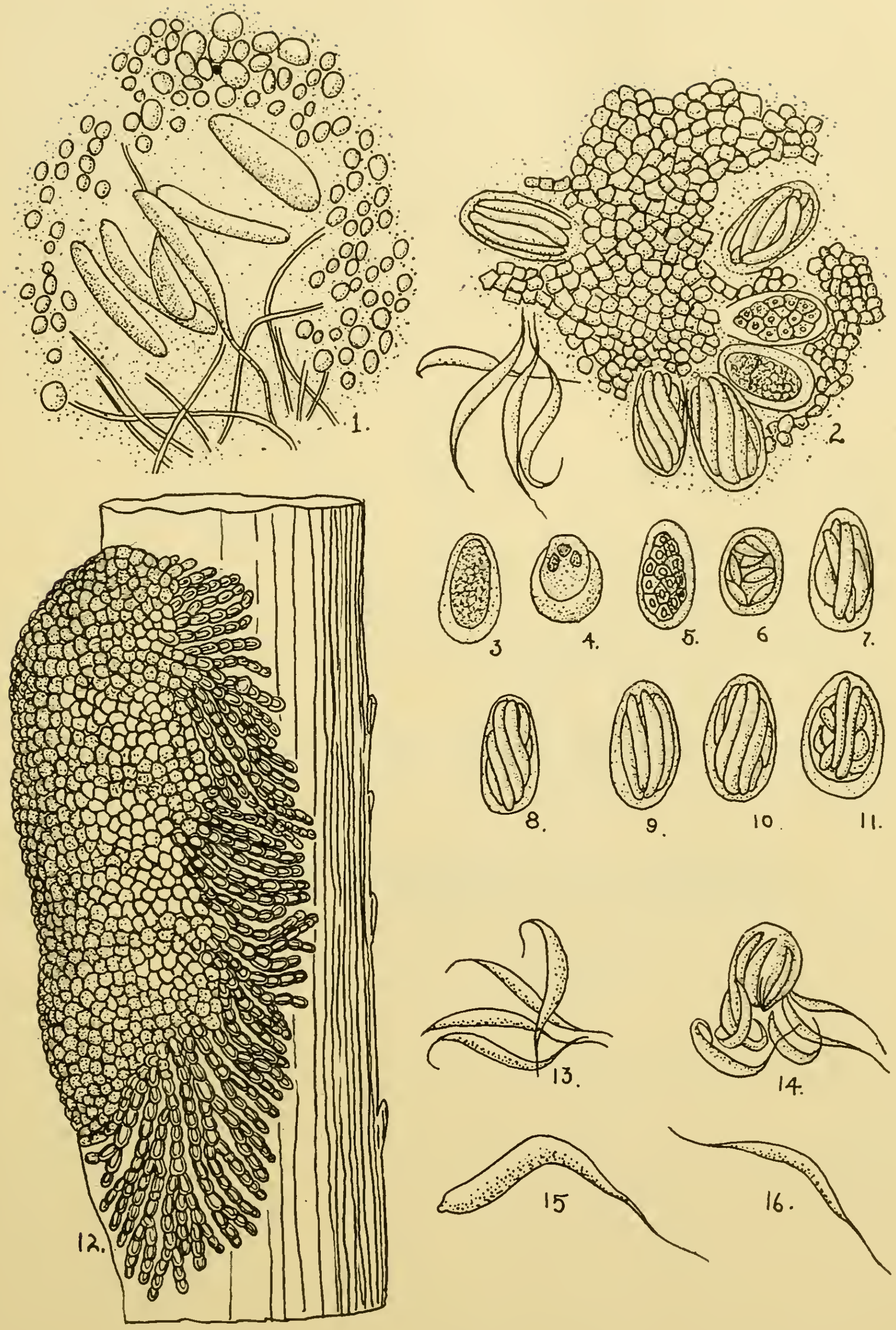
1.
2.
3
4.
5.
6
7.
8.
9.
10
11.
12.
13.
14.
15
16.

Fig. 15.—*Piedraia Hortai.* *1, 2,* sections of masses on hair, showing developing asci; *3-11,* development of ascospores in ascus; *12,* mycelial mass on hair; *13, 15, 16,* ascospores; *14,* ascospores emerging from ascus.

in the lack of ascogenous hyphae, it has nothing in common with that group, and is intermediate between the Spermophthoraceae and the Ashbyaceae.

In *Eremothecium* (Fig. 16), the mycelium is multinucleate and rarely septate. The genus has not been carefully investigated cytologically, but the gametangium (or ascus?) resembles that of *Spermophthora* in shape. The spore number is somewhat less. The spores are fusiform, rounded at one end, tapering to a long filiform appendage at the other. They are arranged in the ascus with the rounded ends in contact and the filiform appendages gathered in a fasicle at the poles, giving the whole spore mass the appearance of a huge nuclear spindle. This grouping suggests that figured by Horta (1911) for *Piedraia.* The protoplasm of the spore is much denser in the end opposite the appendage, and germination takes place only in the end of the spore with the dense protoplasm. No septum has been detected separating the spore into two cells.

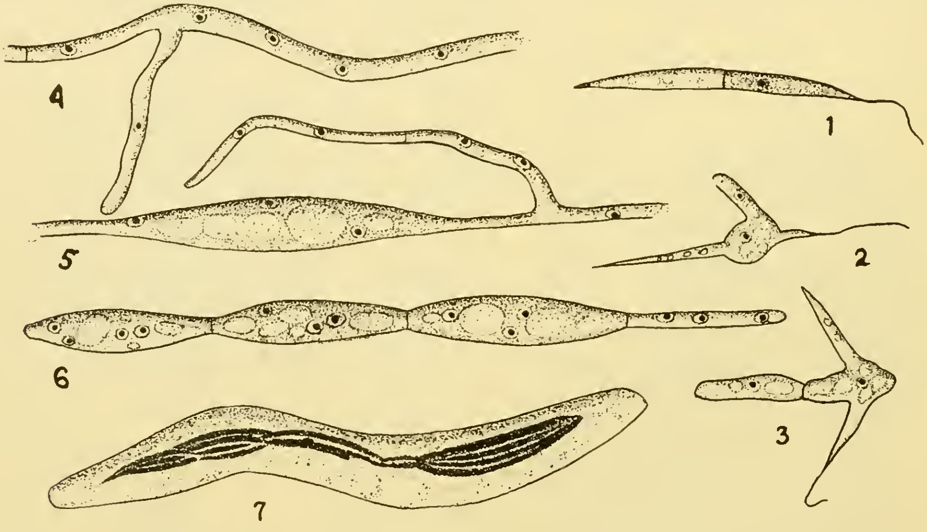

Fig. 16.—*Ashbya Gossypii.* *1,* mature spore; *2, 3,* germinating spores; *4,* mycelium; *5, 6,* development of gametangium; *7,* mature ascus with ascospores. (After Guilliermond 1928.)

In *Ashbya Gossypii,* a parasite on cotton, the mycelium is septate but the cells are multinucleate. Sexuality has been lost, the asci developing parthenogenetically. The nuclei divide twice, forming the tetrads which precede spore formation. This is reminiscent of sporangiospore formation in *Pilobolus* and will be encountered several times in other lines of this group. The number, both of nuclei and of nuclear divisions, is reduced and stabilized so that ordinarily either 8 or 16 spores are produced. The spores are usually rounded at one end and taper at the other into a long slender projection, suggestive of a flagellum, but without motility.

In *Nematospora,* which is also parasitic on plants, degeneration has proceeded further until sprout cells as well as mycelium are produced; the spores are long fusiform to acicular and reduced to 8 per ascus (very rarely 16, or further reduced to 4 or 2 in *N. Nagpuri*). The same flagellar appendage is also present but usually shorter (Fig. 17).

Two other little known genera may either belong here or in the next family. In *Coccidiascus* mycelium is absent, the asci develop following isogamous copulation, and the spore number is fixed at 8 (Fig. 13, *2*). This species has been found in the digestive tract of *Drosophila* but has not been cultivated. In *Monosporella* both mycelium and copulation are absent. The ascus produces a single acicular spore parthenogenetically (Fig. 13, *3*). The members of this genus have also been found in the digestive tract of invertebrates and not cultivated.

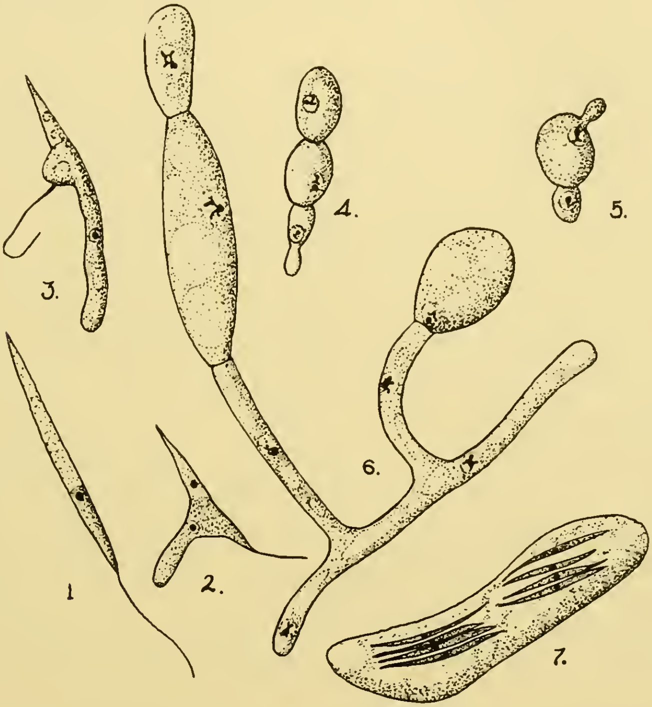

Fig. 17.—*Nematospora Coryli.* *1*, mature ascospore; *2*, *3*, germinating ascospores; *4*, *5*, sprout cells; *6*, developing ascus; *7*, mature ascus. (After Guilliermond 1928.)

PIEDRAIA

Piedraia Fonseca & Arêa Leão, Inst. Oswaldo Cruz, Suppl. das Mem. **4**: 124-127, *2 pls.*, 1928.

Trichosporon Behrend, Berliner Klin. Woch. **27**: 464-467, 1890.

Trichosporum Vuillemin, C. R. Acad. Sci. **132**: 1369-1371, 1901. Arch. de Parasitol. **5**: 38-66, *12 figs.*, 1902, non Fries 1825, 1849.

Fries, *Syst. Orb. Veg.* 306, 1825, published a new genus *Trichosporum* which is spelled *Trichosporium* in the index. No species was attributed to this genus at the time. I can find no mention of the genus in his *Systema mycologicum*

1832. Its first place of effective publication may be considered to be his *Summa Veg. Scand.* **2**: 492, 1849, where he treats twelve species, many of them forming the first section of his *Sporotrichum* in the *Systema.* For spelling we are equally puzzled, as it is *Trichosporum* in the text and *Trichosporium* in the index. Saccardo and later authors have used the latter spelling. In any case Fries' use of the former precludes the possibility of using *Trichosporum* for another genus, and *Trichosporum* of Vuillemin, Schächter, and later medical men, must be renamed. One might consider the retention of *Trichosporon* Behrend, since it differs by the last two letters, but the frequent interchange of spellings of genera, such as *Microsporum* and *Microsporon,* as well as the fact that the spelling *Trichosporum* has had the wider usage in the present century, makes it a permanent source of error and confusion, so that I am in favor of abandoning it altogether.

Fonseca and Arêa Leão (1928) have reported asci and ascospores for *Trichosporum Hortai* and have transferred this species to *Piedraia.* No one has suggested asci in the European species while practically all investigators have noted these structures in the South American species whether they have called them asci or not. Also the lesions in the hair in the case of the European species are much more serious, causing irregular splitting of the hair, suggesting that the European species may belong in some other group of fungi, perhaps remotely related to the Gymnoascaceae or the Eremascaceae. Until more is learned about these imperfectly described species, we prefer to leave them as an appendix of doubtful species of *Piedraia* rather than to transfer them elsewhere.

Piedraia is very imperfectly characterized. Mycelium thick-walled, septate, agglutinating into solid masses on the hair; asci 8-spored; ascospores large, fusiform with acute ends prolonged into filiform appendages.

Piedraia Hortai (Brumpt) Fonseca & Arêa Leão, Inst. Oswaldo Cruz. Suppl. das Mem. **4**: 124-127, *2 pls.,* 1928.

Trichosporum sp. Horta, Mem. Inst. Oswaldo Cruz. **3**: 87-107, *Pls. 5, 6,* 1911.

Trichosporum Hortai Brumpt. Précis Parasitol. 1913.

Forming characteristic hard, black, adherent, small, spherical or long conic nodules on hair, Brazil.

Hyphae septate, 8-12μ in diameter slightly brownish, thick-walled; asci not clearly seen in culture; ascospores fusiform (Fig. 22), curved, greenish yellow, each end acute and prolonged into an appendage about 30μ long, the body of the spore being about 30 × 10μ.

On Sabouraud agar, colonies small, dark brown, very adherent to the medium, velvety, margin somewhat lighter, finally becoming folded. After 10 weeks the whole colony is black. Growth much better on carrots where the lighter colored margin is lacking.

Piedraia Sarmentoi Pereira f., Rev. Med. Cirurg. Brasil **38**: 49-52, *6 pls.,* 1929; C. R. Soc. Biol. **104**: 680, 1930.

Abundant on the hair of young people in the state of Rio Grande do Sul, Brazil.

General microscopic appearance on hair similar to that of *P. Hortai.* Hyphae up to 7μ in diameter. Asci more spherical, up to 30μ long, 8-spored, ascospores 35-40 × 7-8μ, filiform appendages 7-8 rarely 10μ long. In cultures only terminal and intercalary chlamydospores seen.

Growth rapid on Sabouraud agar, colonies white, low margins dentate, creamy then entirely black, fuliginous, easily detachable although penetrating the substrate deeply. Growth slow on potato, and pigment formed very late. On carrot, colony creamy white, pigment first appearing in spots, becoming diffused, fuliginous, cerebriform.

Piedraia surinamensis Dodge, n. sp.

Trichosporum sp. Aars, Arch. Derm. Syphilol. **22**: 401-409, 1930.

Nodosities on hair commonly up to 500μ, rarely 1 mm. long, mostly about 100μ in diameter exclusive of the diameter of the hair, composed of thick-walled cells 4-6μ in diameter. Asci occurring singly, 32-44 × 20μ; ascospores fusiform, 42 × 6μ, with two, seldom three, filiform appendages at the ends.

On maltose agar and honey agar, dark brown to black, hard, slightly velvety colonies.

Piedraia colombiana Dodge, n. nom.

Dematium sp. Juhel-Renoy & Lion, Ann. Derm. Syphiligr. III, **1**: 765-772, *2 pls.*, 1890.

Trichosporum giganteum Vuillemin, Arch. de Parasitol. **5**: 38-66, *12 figs.*, 1902 non Unna 1895.

Producing nodules on the hair in Colombia.

Cells 4-5 × 5-6μ sometimes 8-12μ long, yeastlike and proliferating when young, later forming a mycelium, in old age again becoming more or less yeastlike. Coils were observed in cultures, but it is not certain whether they were functional antheridia and ascogonia. [Malcolm Morris (1879) had previously noted asci with spores, but he does not describe them in sufficient detail. Peña Chavarría & Rotter (1933) describe the ascocarps, asci, and spores in some detail but fail to give measurements of the ascospores.] Brumpt & Langeron (1934) studying a case from Medellín, Colombia, state that the asci were 50 × 30μ, containing 8 ascospores; spores thick-walled, 40 × 6-9μ with very short filiform appendages, 4-5μ long.

On Sabouraud agar, colonies white at first, becoming yellowish, cerebriform, not penetrating the substrate and easily separable. In old cultures the cerebriform appearance is lost. On maltose agar, colonies darker and more adherent. On sugar beets and carrots, growth good. Gelatin liquefaction begins within 8 days.

Piedraia venezuelensis Brumpt & Langeron, Ann. Parasitol. Hum. Comp. **12**: 155-158, *Figs. 27-32,* 1934.

Infected hairs sent by Machado of Caracas from a case of 2 years' duration, apparently the first case reported from this region.

Nodules on the hair, large ovoid or fusiform; asci 35-40μ long, only 4-spored; ascospores 25-30 × 10-14μ very thick-walled, lacking filiform appendages but ending in long slender points up to 10-12μ long, often somewhat curved.

Not cultivated.

Species of Doubtful Position

The following species are rather imperfectly described and may belong elsewhere, although they were placed here by the original authors. In some cases I have been unable to locate the original description and know the name only by a brief mention in the literature.

Trichosporum Beigelii (Rabenhorst) Vuillemin, Arch. de Parasitol. **5**: 38-66, *12 figs.*, 1902.

Pleurococcus Beigeli Küchenmeister in Rabenhorst, Hedwigia **6**: 49, 1867.

Sclerotium Beigelianum Hallier, Paras. Unters. 75, *Pl. 2, Figs. 24, 25,* 1868.

Zoogloea Beigeliana Eberth, Centralbl. Med. Wiss. **11**: 307, 1873.

Hyalococcus Beigeli Schroeter, Kryptog. Fl. Schlesien **3**: 152, 1886.

Chlamydotomus Beigeli Trevisan in Saccardo, Syll. Fung. **8**: 1042, 1889.

Micrococcus Beigeli Migula, Syst. Bakterien, **1**: 193, 1900.

Attacking the hair in wigs and switches, Germany. Vuillemin (1902) isolated what he called this fungus from the hairs of the moustache. The report of this fungus from pubic hair in Nigeria by Manson-Bahr (1932) probably should be referred to *Favotrichophyton.*

Cells 3-5μ in diameter, spherical or angular by mutual pressure, surrounding the hair in a spherical mass of gel; sporangia mostly 1μ thick, containing 12-20 spores.

Vuillemin describes the fungus isolated by him as follows: Cells 2.5-4μ, mostly 3-4μ, wall thick, held together by gelification of the outer layer of the wall. Larger chlamydospores in the interior of the stroma, 6μ in diameter.

On maltose agar, gelatin, carrot, beet, and potato, a yellowish gray, humid colony, becoming convoluted, surface drying chalky white. Cells cylindric, 4-5μ in diameter, forming a more or less dichotomous mycelium about 2μ in diameter, producing hypnospores filled with reserves up to 12μ in diameter. Gelatin and serum not liquefied. Producing a pellicle on the surface of liquid media, growth suggesting that of *Geotrichum lactis.*

Trichosporum ovale Paoli, Giorn. Ital. Mal. Ven. Pelle **54**: 566-572, 1913, non Unna ap. Vuillemin 1902.

Isolated from infected hairs of the moustache with the usual trichosporic nodules, hair not breaking readily.

Spores in nodules 3-4μ, hyphae present. In cultures, mycelium of branched, septate hyphae bearing terminal chains of spores often suggesting clostero-spores. Not pathogenic for guinea pig or rabbit.

On Sabouraud agar, colony whitish, moist, radially furrowed, slightly velvety, becoming yellowish. On gelatin, colony similar but growth much slower, gelatin liquefied in 13-15 days. On broth, grayish white pellicle settling after 6-7 days and replaced by another pellicle.

From the brief description, the systematic position of this organism is uncertain. Many characters suggest much closer relation to the *Favotrichophyton ochraceum* group rather than to the yeasts (near *Mycotorula*). Clinically it seems very close to the European *T. Beigeli*, if it be not the same organism.

Trichosporum ovoides Behrend, Berliner Klin. Woch. **27**: 464-467, 1890.

Trichosporum ovale Unna ap. Vuillemin, Arch. de Parasitol. **5**: 38-66, *12 figs.*, 1902.

?*Trichosporum giganteum* Unna, Deutsch. Med. Zeitschr. **1895**: 255-256, 1895, non Vuillemin 1902.

Isolated from sycosis in Germany, forming brownish yellow nodes on the hair, leaving the hair shaft nearly intact.

Spores ovoid, 2-4.5 × 1-4μ, sometimes irregular.

Colonies cerebriform, blackish brown on several media.

Trachsler (1896) tried to separate *T. ovoides* and *T. giganteum*, but the differences between the strains are so slight that they are probably not significant.

Trichosporum glycophile DuBois, Ann. Derm. Syphiligr. V, **1**: 447-456, 1910.

Causing irritation in female genitalia. The hairs which have been moistened with urine (patient was a mild diabetic) have nodosities and terminate in brushlike tips, often breaking a few millimeters from the skin. The mycelium proliferates between the fibrillae of the hair and terminates at the surface under a layer of sporiform elements. Not pathogenic for the guinea pig, rabbit, or rat.

The following description of morphology based on cultures from 5% maltose agar, 5% peptone agar, or 2.5% maltose + 2.5% peptone agar. The yeast cells 5-6μ in diameter. The hyphae slender, septate, at long intervals, uniform at least in the terminal portion. As the hyphae become older, they become thicker, more tortuous, and end in a terminal swelling. Spores verticillate, regularly spaced. Chlamydospores large.

On solid sugar media, abundant mycelium below the surface while on the surface a small gray colony scarcely covers the hair. On solid protein media, colonies yellowish, smooth, humid, proliferating on surface with central elevation and sometimes with little knobs, margin with a circular elevation connected with the center by furrows. Cross inoculations showed these two types of colonies to be the same organism. On Sabouraud agar, colonies smooth gray, or yellowish, growth rapid. On broth agar and peptone agar, yeast form prevails on the surface, growth slow, colony gray, smooth with a slight central knob, colony bordered by fine hyphae at the end of 3 weeks. On liquid media, grayish white pellicle, dry but not powdery, pellicle settling in 10-12 days and a new one forms. On potato, colonies gray yellowish, moist, rugose.

Gelatin not liquefied, but fine hyphae perpendicular to the line of the stab seen and a tuft of mycelium at the bottom.

The systematic position of this species is not at all clear. Its behavior on the hair suggests relationships with the European species previously placed in *Trichosporum.* On the other hand, this organism caused considerable irritation of the genitalia while the so-called *Trichosporum* of Vuillemin and others caused no irritation. Its morphology in culture would relate it to *Mycotorula* as has already been pointed out by Langeron & Talice (1932), but none of the other species of the group have been reported able to penetrate the hair.

Trichosporum equinum Fambach teste Fonseca, Rev. Med. Cirurg. Brasil **38**: 256, 1930.

Producing white nodules on hair of horse, becoming yellowish or darker.

Trichosporum Foxi Castellani, 1908.

Pichiaceae.—The systematic position of this family is not clear. It may have arisen from *Nematospora* or *Ashbya* or, more probably, as another line of degeneration from the Ascoideaceae. The most primitive member is *Guilliermondella* which produces considerable mycelium with conidia. Asci 4-spored, either lateral or intercalary, follow isogamous copulation or may develop parthenogenetically. Spores sickle-shaped [Dekker (1931) figures them as kidney-shaped very close to those of *Pichia*]. A somewhat more degenerate species, *Guilliermondella Vuillemini* (*Endomyces albicans* Vuill. non Johan-Olsen, *Endomycopsis albicans* Dekker) from a case of thrush, still retains both mycelium and sprout mycelium. The spore number is 4, or fewer.

In *Zygopichia* and *Pichia* there are cylindric cells and some mycelium formation, forming a thick, dry pellicle on the surface of liquid media. In *Zygopichia* heterogamous copulation precedes ascospore formation, in *Pichia* the degeneration is complete, and the ascospores develop parthenogenetically. Both genera have kidney-shaped, hemispheric, or angular ascospores.

Guilliermondella Vuillemini (Lindau?) Dodge, n. comb.

Endomyces albicans Vuillemin, C. R. Acad. Sci. **127**: 630-633, 1898; Rev. Myc. **21**: 43-45, *Pls. 189-190,* 1899 not Johan-Olsen 1897 (excl. all syn. based on *Oidium albicans* Robin).

Endomycopsis albicans Dekker (excl. syn.), Verhandel. K. Akad. Wetensch. Amsterdam, Afd. Natuurk. **28**: 231, 1931.

Endomyces Vuillemini Lindau?, Mikroscopische Pilze 1912 [cited as Landrieu by Castellani & Chalmers, Man. Trop. Med. ed. 2, 1913, but I am unable to verify this citation].

Isolated from a case of thrush.

Yeast cells abundant at first, giving rise to mycelium with chlamydospores and finally producing asci, spherical or ellipsoid, 4-5μ, 4-spored, rarely 2-3-spored, axes of ascospores 3.8-3.5 × 1.75-2 × 1.2-1.4μ, not staining with nuclear stains (i.e., the deeply staining bodies called by Vuillemin the "globules internes" are probably nuclei, *fide* unpublished work of Morris Moore). The ascospores cling together in groups for some time after the asci have disappeared.

Ascoideaceae.—In *Ascoidea rubescens* in the slime flux of trees, the mycelium is coenocytic, septate, and branched. The mycelium produces conidia either singly or in tufts. The gametangium is a large multinucleate cell. Varitchak has reported the degeneration of all but one pair of nuclei, which proceed to fuse. Walker (1935) was unable to confirm this statement and suggests that the "privileged sexual nuclei" of *Ascoidea* are degenerating nuclei which she has also seen in other parts of the fungus. By two or three successive divisions the spore initials are cut out of the mass as lenticular, uninucleate portions of the protoplasm. Finally, these spore initials contract and form the typical cucullate spores of this series. Not all of the protoplasm is used up in the process, some remaining behind as the epiplasm, as in other groups of Ascomycetes. The ascospores are extruded from the mouth of the ascus by the proliferation of the cell next below it. This proliferating cell proceeds to form another ascus at the same site. Plasmogamy occurs shortly after spore germination, but the occurrence of caryogamy is still uncertain. The spore sac appears similar to the gametangium of *Spermophthora,* but gametes are not differentiated and whether there is nuclear fusion in this organ is still questioned. In its later stages the organ behaves as a multispored ascus, although ontogenetically it bears little relation to such a structure. The proliferation of the basal cell into the mature organ suggests sporangial proliferation in the Saprolegniaceae, but the manner of spore formation is entirely different. It would seem likely that we are dealing with a stage of degeneration from an ancestral form like *Spermophthora* in which the gametangium has ceased to function as such and functions as an ascus with a shortening of the stages between gametangium and ascus and with a partial or complete elimination of the sexual act. The fact that the spore initials appear similar to the ascospores of *Spermophthora* and finally become cucullate as in the Endomycetaceae, suggests that it may be an intermediate stage in the phylogeny of the latter.

Endomycetaceae.—In this family the mycelium is usually uninucleate, soon degenerating to sprout mycelium, conidia are no longer differentiated, the ascospore has become reduced in number per ascus and has assumed a cucullate or saturnine shape.

So far as is known this family is saprophytic, although *Hansenula* has occasionally been isolated from sputum, and Pijper (1928) reports *Hanseniospora* from a case of onychomycosis. The strains of fungi from these isolations have not been reported pathogenic for experimental animals. It is possible that they may cause irritation in the mucous membranes or aggravate a condition primarily due to some other organism, but reports of the cases should be scrutinized very carefully before admitting them as pathogens. On the other hand, there is a large group of parasites previously referred to *Endomyces,* having spherical to ellipsoid, smooth spores, which is here treated in the Eremascaceae.

This family is characterized by the rim around the spore, producing a cucullate spore if the rim is on one side, or a saturnine spore if the ring is equatorial. Within the family there is a large isogamous series and a small heterogamous one.

In the heterogamous series, which seems to be the more primitive, we have *Endomyces Magnusii* (*Magnusiomyces*) from the slime flux of trees (Fig. 18). The hyphae are generally multinucleate (2-8). In growing hyphal tips this number may mount to 50 (Fig. 18, *1*), in weak hyphae it may be as low as one. The hyphae divide easily into oidia; which are generally multinucleate, rarely uninucleate. In successive divisions the tendency is toward the uninucleate condition. Often their wall thickens and the oidia become hypnospores (Fig. 18, *10*); with the consequence that, under certain environmental conditions, a culture may disintegrate into hypnospores after a couple of weeks.

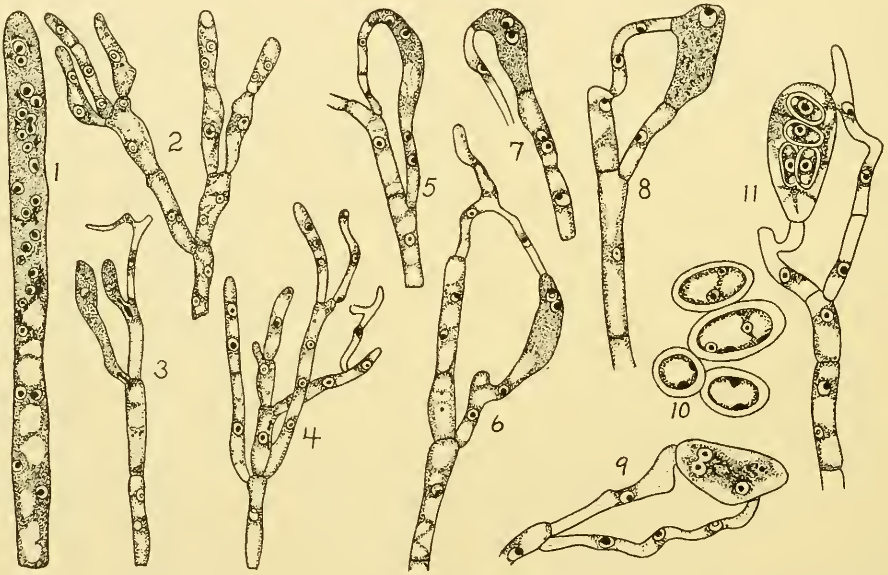

Fig. 18.—*Endomyces Magnusii.* *1*, young multinucleate hypha; *2*, older hypha; *3-9*, *11*, development of asci; *10*, hypnospores. (*1*, *2*, *10* ×1,500; *3-9*, *11* ×500.) (After Guilliermond 1909.)

With favorable conditions, oidia may develop to sprout mycelia, not by independent development of small outgrowths of the mother cell to sprout cells but by fission of the mother cell. Both daughter cells round off and develop to the size of the mother cell (ordinary cell division in contrast to sprouting).

When the mycelium is ready to form asci, it divides into numerous short, slender branches with short cells containing few nuclei, often not more than one (Fig. 18, *3*, and *4*). A branch ends either in a very large cell full of reserves, the ascogonium, or in a narrow hyaline cell, often much twisted, the antheridium. The upper third of the ascogonium swells considerably and collects the cytoplasm with 2 or 3 nuclei. At the beginning of copulation, it bends over to meet the antheridium. In this stage, the swollen part contains only one nucleus, the others having migrated (Fig. 18, *5*). The narrow antheridium contains, when young, 1-3 nuclei of which only one remains at the tip. In about three-fourths of the cases, copulation occurs. The antheridium approaches the ascogonium, swells slightly, and abjoints the apical uninucleate gametangium from the stipe cell. Meanwhile the uninucleate tip of the ascogonium is abjointed from its basal cell. Hereupon the walls separating the gametangia dissolve, with the development of the zygote to a 4-spored ascus (Fig. 18, *6-9*).

There often occur numerous variants of this usual course of development. Thus, the antheridium may approach the ascogonium at the side instead of the tip; or both may be uninucleate without the abjunction of basal cells; or the ascogonium may develop parthenogenetically.

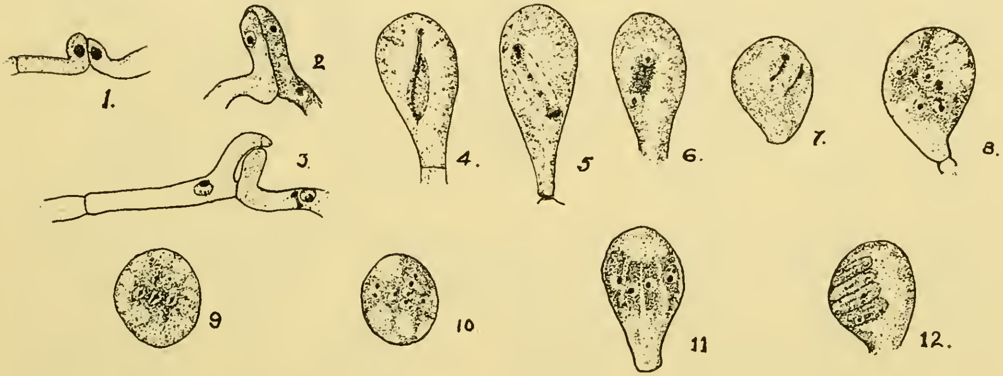

Fig. 19.—*Endomyces decipiens.* *1-3,* stages of copulation; *4-12,* development of asci. (×1,200.) (After Juel 1921.)

The end member of the heterogamous series is *Endomyces decipiens,* found on fructifications of the mushroom, *Armillaria mellea,* producing its perfect stage on the lamellae. Sexual organs are almost entirely absent, copulation being heterogamous when present or very rarely isogamous (Fig. 19, *1-3*). The asci are lateral on the hyphae. Although sometimes three nuclear divisions occur in the ascus, only 4 ascospores are formed (Fig. 19, *4-12*). In cultures the hyphae easily break apart into uninucleate oidia. Sometimes the tips of branches form thick-walled yellowish hypnospores instead of asci.

The isogamous series begins with the genus *Endomycopsis.* In this genus the abundant sprout mycelium is apparently connected with the adaptation of these species to media containing starch and sugars. Wherever the sprout cells arise on aerial mycelium, their diameter is smaller and the wall somewhat thicker than in the submersed sprout cells. They are then very resistant and survive a long period in temperatures up to 55° C. Biologically their significance seems to be that of hypnospores, and because of their exogenous formation they are usually called conidia.

In *Endomycopsis fibuliger,* although any two cells may form copulation branches which approach each other, even with the dissolution of the wall the 2 nuclei rarely fuse (Fig. 20, *1*). Generally the copulation branches develop parthenogenetically, though the separating walls may be temporarily dissolved. In exceptional cases there may occur a pseudogamous anastomosis of two sprout cells, one changing to an ascus. (Fig. 20, *2-4*).

In a large number of cases no copulation branches are formed, but the asci, like the sprout cells, arise as lateral outgrowths of the hyphal cells (Fig. 20, *6*). These asci are three or four times larger than the ordinary sprout cells. Occasionally, they arise from ordinary swollen hyphal cells, or from swollen sprout cells. When they begin to appear, the formation of sprout cells slows up, but does not cease, with the result that hyphae may form sprout cells and asci simultaneously. One finds even young asci which continue to cut off sprout cells until the beginning of spore formation. Periods of vegetative growth and fructification are thus not sharply differentiated one from the other. Each ascus contains four cucullate spores. At germination, these throw off the exospore and germinate either with a germ tube or with a sprout mycelium. Here sexuality is so completely weakened that only vestiges of the sexual organs remain. In a large number of cases where no copulation branches are formed, the asci arise directly from vegetative hyphae or sprout cells.

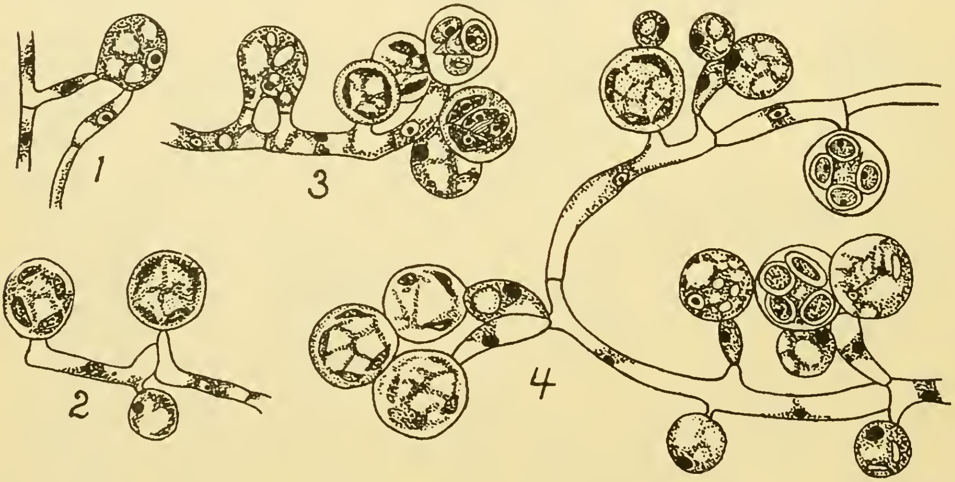

Fig. 20.—*Endomycopsis fibuliger.* Development of asci. (×500.) (After Guilliermond 1909.)

In the remaining forms of the isogamous series, copulation branches develop less frequently and the asci arise parthenogenetically without fusion. Growth of mycelium by sprouting increases proportionally. In two Chinese species, *E. Lindneri* and *E. Hordei,* the copulation branch no longer changes directly to an ascus but develops to a short, occasionally branched mycelium where asci arise by swelling of the hyphal cells (Fig. 21, *1, 2*). In most cases the asci are formed directly from the sprout cells without this detour.

In other species which terminate the isogamous series, *E. javanensis* and *E. capsularis,* the copulation branches have entirely disappeared (Fig. 21, *6-8*). According to the conditions of environment, either the hyphal or the sprouting condition may prevail. By swelling of the terminal cells of the hyphae or by lateral sprouting (sometimes also intercalary), there arise 4-spored asci. Each of these spores is divided into two unequal parts by annular thickenings (Guilliermond 1909). Neither species is possessed of much fermentative ability.

From *Endomycopsis* two lines diverge. In *Hansenula* the ascospore is cucullate, the mycelium has disappeared, although the cells are quite elongate and sometimes in chains. Two of the sprout cells form copulation tubes toward each other, the nuclei migrate into the bridge and fuse, the diploid nucleus divides, both daughter nuclei migrate back into the cells, there divide a second time, and develop two ascospores in each fusion cell. In *Hanseniospora* the cells of the sprouts mycelium are mostly citriform, sprouting only from the poles. Copulation has not been observed and apparently the ascospores develop parthenogenetically. Pijper (1928) reports *H. Guilliermondii* from the nails in a case of onychomycosis.

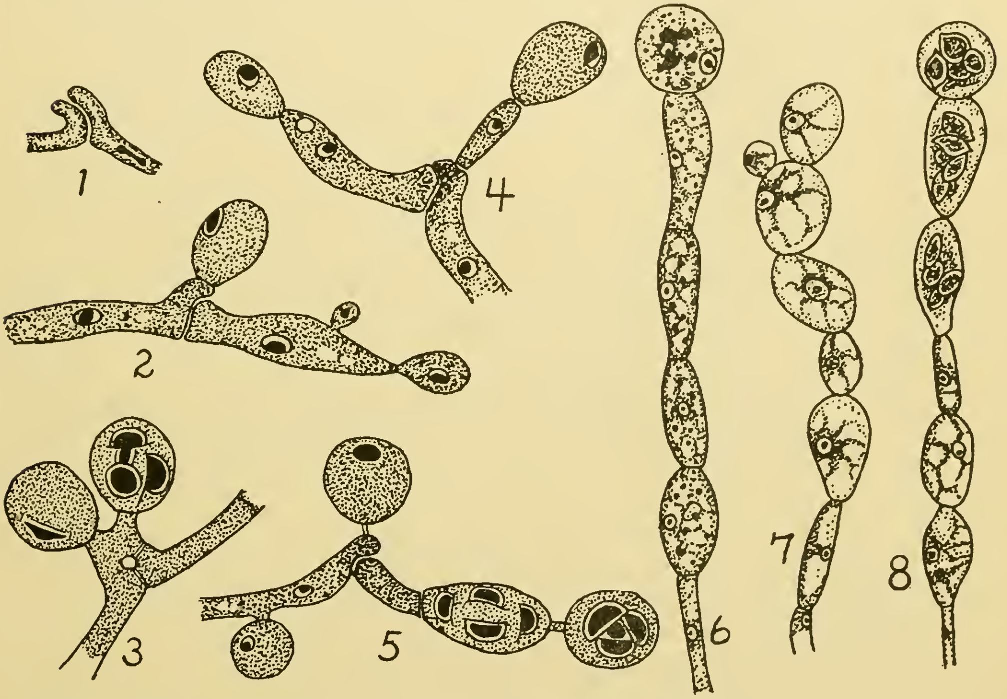

Fig. 21.—*Endomycopsis Lindneri.* *1-5, E. capsularis; 6-8,* development of asci. (*1, 2, 6-8* ×470; *3-5* ×500.) (After Mangenot 1922 and Guilliermond 1909.)

In the other line diverging from *Endomycopsis,* the ring about the ascospore occupies an equatorial position. In *Williopsis saturnus* we have vegetative conditions very much as in *Hansenula,* where this species was formerly placed.

Copulation is reported to occur between ascospores before germination. The end member of this series is *Schwanniomyces*, where the spore is rough as well as saturnine, the spore number is usually 1 per ascus, very rarely 2. Projections simulating copulatory canals are produced, but the asci develop parthenogenetically.

Key to Genera

Mycelium present and well developed, no assimilation of nitrate.

  Copulation heterogamous; no sprout mycelium, although the cells of the mycelium break apart into arthrospores; a thin pellicle on malt, also on ethyl alcohol. *Endomyces.*

  Copulation isogamous, sprout mycelium also present, pellicle thick, often gelatinous, on malt, none on ethyl alcohol. *Endomycopsis.*

Mycelium absent although a pseudomycelium of sprout cells may be formed.

  Ascospores cucullate.

    Yeast cells elongate, or ovoid; copulation present; nitrates assimilated; thick, wrinkled pellicle on malt, often dry and powdery, fermentation of sugars positive, pellicle on ethyl alcohol. *Hansenula.*

    Yeast cells citriform, sprouting only from the poles, no copulation, nitrates not assimilated, no pellicle on malt, only weak fermentation of glucose, no growth on ethyl alcohol. *Hanseniospora.*

  Ascospores saturnine, yeast cells ovoid or spherical, copulation of ascospores before germination reported, nitrates assimilated; thick, wrinkled pellicle on malt, fermentation of sugars positive, pellicle on ethyl alcohol. *Williopsis.*

  Ascospores saturnine and rough, yeast cells ovoid, copulatory canals formed but not functional, nitrates not assimilated, usually only a thin ring on malt, occasionally a slimy pellicle; fermentation of sugars positive, very poor growth on ethyl alcohol. *Schwanniomyces.*

HANSENULA

Hansenula Sydow, Ann. Myc. **17**: 44, 1919.

Willia Hansen, Centralbl. Bakt. II, **12**: 529, 1904 not *Willia* Müll.

The type species is *Hansenula anomala* (Hansen) Sydow.

Yeast cells ovoid to elongate, multiplication by sprouting, the sprout cells often clinging together in chains. On liquid media containing sugar a thick pellicle formed, dry and dull from the included air; fermentation of sugars positive, aesculin hydrolyzed, nitrate assimilated, good growth with pellicle formation on ethyl alcohol; ascospores cucullate, 1-4 per ascus.

Hansenula anomala (Hansen) Sydow, Ann. Myc. **17**: 44, 1919.

Saccharomyces anomalus Hansen, C. R. Trav. Lab. Carlsberg **3**: 44, 1891. Ann. Micrographie **3**: 467-474, 1891.

Willia anomala Hansen, Centralbl. Bakt. II, **12**: 529, 1904.

Willia anomala var. Beauverie and Lesieur, Jour. Physiol. Path. Gén. **14**: 991, 992, 1912.

Saccharomyces Beauveriei Froilano de Mello, Arq. Hig. Pat. Exot. **6**: 246, 1918 [based on case of Beauverie & Lesieur 1912].

Reported occasionally from sputum but in none of the cases has pathogenicity been clearly shown. Beauverie & Lesieur (1912) reported a case of phthisis with the organism in the mucopurulent sputum. Grigorakis and Péju (1922) also report a case. Shrewsbury (1930), in a monograph on the genus, reports his strain 209 isolated from sputum from a case of chronic bronchitis along with *Monilia,* and an unidentified yeast. Shrewsbury was unable to find any pathogenicity for his strain on experimental animals.

Pseudomycelium formed on many media, especially in pellicles on liquid media. On carrot at 26° C. in 6 days, cells spherical or ovoid, 3-8 × 2.5-6μ. Sporulation on carrot juice in the pellicle after 55 hours, cells 3-8μ in diameter. Asci spherical, ascospores typically cucullate.

Colonies cream white, smooth, and shining. Usually developing a strong odor of fruit ethers.

Hansenula bispora (Mattlet) Nannizzi, Tratt. Micopatol. Umana [Pollacci] **4**: 134, 1934.

Saccharomyces (*Willia*) *bispora* Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 32, 33, 1926.

Isolated from stools of patients with various degrees of dysentery. Pathogenicity not proved; animal experiments not yet reported in detail.

In potato decoction at 37° C. after 3 days, spherical or ovoid cells containing a vacuole and granulations, 2-10μ, budding, larger cells 6-7μ or rarely pyriform 11 × 7μ, thick-walled granular with little or no vacuole, other cells elongate, swollen at one end, the smaller tip of one against the swollen tip of the other and showing isogamous copulation. After about 10 days, oil droplets abundant in most of the cells or occasionally droplets unite into one large drop, copulation forms rarer. Little change in appearance after 30 days.

On Gorodkova agar asci appear after 5 days, thick-walled, containing 2 cucullate ascospores 6 × 3μ. On Sabouraud agar colonies white dull, circular with even margin, in age the center becomes yellow and a few radiating folds develop. On gelatin stab, slight liquefaction with some gas formation. In potato decoction, abundant deposit of yellowish white clots which dissolve in the liquid on shaking. Optimum temperature 37° C. Litmus milk slightly acid. Acid and gas on glucose, fructose, maltose, galactose and sucrose; very slight acid on dextrin, no action on lactose and mannite.

HANSENIOSPORA

Hanseniospora Zikes, Centralbl. II, **30**: 145, 1911.

Yeast cells citriform or elongate ovoid, vegetative multiplication by bipolar sprouting; no pellicle on malt, spores spherical at first, then cucullate (ability to form spores easily lost on cultivation), only glucose slightly fermented, nitrate not assimilated, practically no growth on ethyl alcohol.

Hanseniospora Guilliermondii Pijper, Proc. Sect. Sci. K. Akad. Wetensch. Amsterdam **31**: 989-992, *2 figs.,* 1928.

Isolated from onychomycosis of European woman in Pretoria; pathogenicity quite probable but not proved.

Growth good at both room temperature and at 37° C. On fluid media cells citriform or ellipsoid, 5.2 × 2.4μ. In old cultures a slight tendency toward "mycelium" formation. Vegetative development by sprouting. No trace of sexual process, spores normally 4 per ascus, cucullate, becoming spherical on germination. A tubelike protuberance is put out which leaves the spore and takes on the characters of the ordinary vegetative cell. While sexuality has disappeared there is evidently some physiologic differentiation of the spores. After mordanting with chromic acid, staining with carbolfuchsin, decolorizing with sulphuric acid, and counterstaining with methylene blue, the equatorial pair of spores were acid-fast while the polar pair were blue.

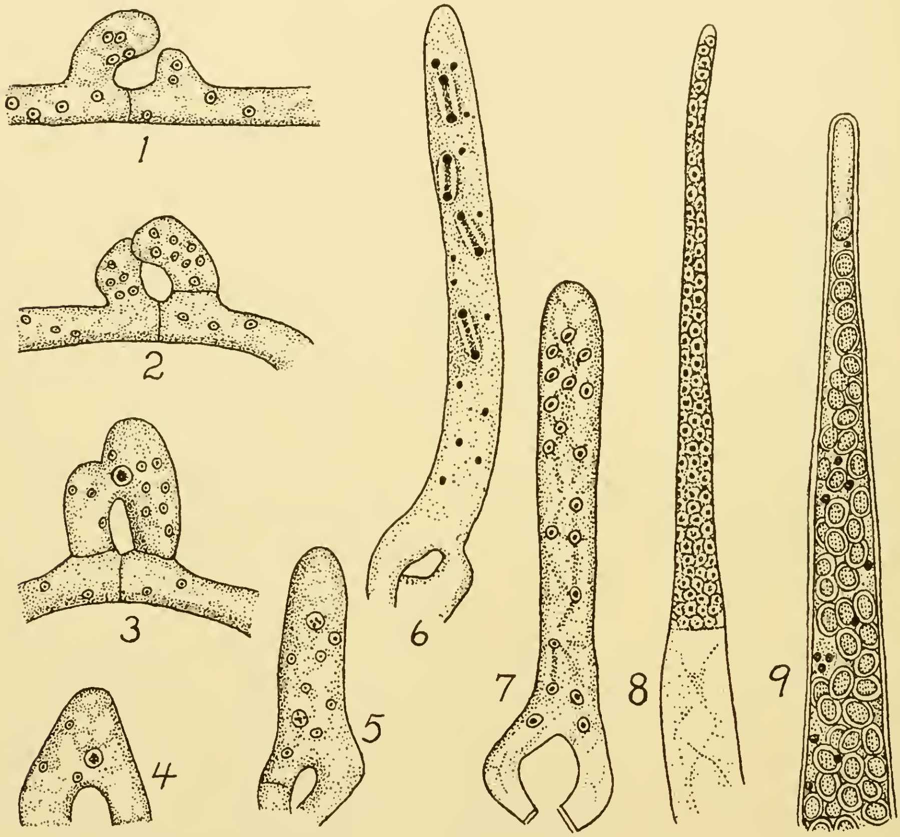

Fig. 22.—*Dipodascus albidus.* *1, 2,* young copulation branches not yet abjointed; *3, 4,* diploid nucleus in female copulation; *5,* first step in division of diploid nucleus; *6,* later stage; *7, 8,* later stages of young ascus; *9,* upper portion of nearly mature ascus, the dark points indicating degenerate nuclei. (*1, 2, 5-9* ×900; *3* ×800; *4* ×600.) (After Dangeard 1907, Juel 1902.)

Giant colonies on malt agar, grayish brown, edge lobulated, surface smooth showing very delicate concentric rings corresponding to the days of growth, no radial lines, a central knob present from the beginning and later secondary knobs appear at various places.

Acid formed in raffinose, sorbite, and dextrin and a small amount of gas in glucose and fructose. No action on any of the other common sugars and glucosides. Malt gelatin liquefied slowly. On all liquid media, growth took place at the bottom only, no pellicle formed, even after many months.

Dipodascaceae.—In *Dipodascus,* the mycelium is septate, but the cells are coenocytic. The copulation of two hyphal cells produces gametangia (Fig. 22, *1-2*). Fusion of the gametangial nuclei occurs without differentiation of the gametes. The formation of diploid mycelium has disappeared and the ascospores are formed in the gametangium without differentiation of an ascus (Fig. 22, *3-7*). From this stage we have two main lines of divergence, one through *Eremascus* to the true yeasts, and one through *Pericystis* to the Coccidioideaceae. A third possible line has ended blindly in *Actonia,* a genus whose life cycle is not well known.

In *Actonia tropicalis,* the mycelium is septate and may multiply by sprouting. A round gametangium (sporangium) forms at the end of a filament and develops small motile gametes (zoospores), which are apparently forced out of the gametangium by the invagination of the basal wall. Whether this phenomenon is comparable to the proliferation of *Ascoidea* or is related to columellar formation in the Mucorales is uncertain. The further fate of the gametes (''zygospores'') was not described. Whorls of sprout cells are sometimes produced on the hyphae. After some weeks on Raulin's medium, ascospores (?) are formed. ''At the end of a filament a round body appears with a well-marked external capsule and a small green body in its center. This body becomes flat and disklike, and from it four ascospores bud off. The four ascospores are surrounded by a limiting membrane which is extremely difficult to see because of its transparency. The greatest care has to be taken not to rupture the membrane. When rupture does occur, the membrane is coiled up under the parent cell and appears to be double'' (Acton 1919). This, if correctly reported by its author, is quite similar to the peculiar spore formation we find in *Paracoccidioides* and reminiscent of partial sporangial formation in the higher Mucoraceae. When the morphology and cytology of this organism is better known, perhaps it will be found related to *Paracoccidioides* and *Histoplasma* rather than to the Dipodascaceae.

In *Pericystis alvei* (Betts 1912, Claussen 1921) the mycelium is differentiated sexually, and copulation is heterogamous. Its cytology is unknown, but the ascus is spherical and contains many spores, suggestive of conditions found in the Coccidioideaceae-Taphrinaceae line.

ACTONIA

Actonia Dodge, n. gen.

Mycelium cellulis curtis, crassis gemmiparis; zoosporangia terminalia, zoosporis motilibus, sphericis, e zoosporangiis ab basis invaginatione ejectis; conidia verticillata, ovoidea gemmipara; hypnosporae endogenae in hyphis veteribus; asci terminales, spherici, tetraspori.

Mycelium of short, stout cells, often multiplying by sprouting; zoosporangia terminal, producing motile, spherical zoospores which are ejected from the sporangium by the invagination of the basal wall; conidia in whorls, ovoid, germinating by sprouting; endogenous hypnospores formed on old mycelium. Asci terminal, spherical, 4-spored.

Type species is *Endomyces tropicalis* Acton non Castellani.

If the observations of the author are correct, this is a very curious fungus with a life cycle quite different from any other genus of fungi known, and the only place where motile gametes or zoospores have persisted in the *Ascomycetes*. It is possible, however, that flagelliform appendages of gametes similar to those in *Spermophthora* were observed, or else that a contamination from some member of the Phycomycetes has been confused with some ascogenous fungus.

Actonia tropicalis (Acton) Dodge, n. comb.

Endomyces tropicalis Acton, Indian Journ. Med. Res. **6**: 591-600, 1919; not *Endomyces tropicalis* Castellani, Centralbl. Bakt. I, **58**: 236-238, 1911.

Monilia Actoni Vuillemin, Champ. Paras. Homme Anim. 84, 1931 nom. nud.

Producing small creamy patches on the tonsils and uvula in throats of soldiers in Mesopotamia. The patches are difficult to remove but leave no raw bleeding surfaces. There is diffuse inflammation of the uvula, pillars of the fauces, and the posterior pharyngeal wall. In debilitated persons it may extend to the bronchi and bronchioles, causing fatal bronchopneumonia.

Both sprout cells and mycelium present; gametes produced in spherical sporangia. Their development is not altogether clear from Acton's description, some of the phenomena suggesting proliferating sporangia of *Ascoidea* or of the Saprolegniaceae. Chlamydospores present. Ascospores budded off the ascus somewhat as in *Paracoccidioides*.

On 1% sucrose agar, colony ivory white with raised crenate edges; becoming creamy yellow and sticky in a few days, mycelium also penetrating the agar. On litmus milk, growth scanty, acid on the third day without coagulation. On Raulin's solution, slight cream colored growth at the bottom of the tube. Ascospores in 2-6 weeks. On carrot, growth luxuriant, sticky, brown.

From the stage attained by the Ascoideaceae two other lines of development diverge. One line has retained the large number of spores in the ascus, developed the ascus as a thick-walled resting spore, with a tendency to delay spore formation until the protoplasm has slipped out of the ascus. The nuclear history of most members of this line is so little known that there is doubt as to whether sex has been retained, although the large nucleus (in some species) in the very young ascus suggests that a fertilization has taken place and the occurrence of spores in tetrads during one stage of development, in several genera, suggests a reduction division. Finally spore number is reduced in some species of the Taphrinaceae to 4 or 8, but so many intermediate forms exist and the number is so inconstant that it has been abandoned as a generic character. Along with this goes the elimination of the thick-walled resting stage of the young ascus. The collection of asci into more or less definite fructifications or ascocarps within the host tissue has been attempted in the end member (Taphrinaceae) where, in some species the clavate asci form a palisade layer under the epidermis of the host.

The other line has early reduced the number of ascospores to a small, definite number, 8, 4, 2, or 1 and, perhaps owing to their habitats, have gradually diminished the amount of mycelium until in the Saccharomycetaceae, true mycelium has disappeared. For further discussion of this line, especially the steps in the gradual disappearance of sexuality, see Chapters XI and XII.

Coccidioideaceae.—This family has four genera causing more or less similar lesions in man and in experimental animals, with no saprophytic species so far recorded. Three of the genera are monotypic, from widely separated and rather restricted localities. *Coccidioides* is mostly restricted to California, Uruguay, and Argentina. *Paracoccidioides* to Brazil, while *Rhinosporidium* has been reported from Argentina, India, and the Mississippi Valley. *Histoplasma* is known in the Mississippi Valley and in Panama.

The large indefinite number of ascospores (Fig. 23, *19*) suggests conditions found in the Ascoideaceae, but no conidial stage is known. Along with increasing specialization for strict parasitism in this family, sexuality has apparently disappeared without a trace.* The mycelium is septate and multinucleate as in the preceding family. In the host, however, it tends to less and less development until occasionally in *Coccidioides* it may be absent, and the ascospore grows *in situ* to an ascus without any cell division. In *Rhinosporidium,* this may be the normal condition. A similar disappearance of mycelium is found in the Eremascaceae—Saccharomycetaceae line. In *Histoplasma,* large functionless tubercles are formed on the walls of the ascus, while in *Paracoccidioides,* the ascospores migrate into the tubercles and are discharged by the rupture of the wall, suggesting partial sporangia of the Mucoraceae.

COCCIDIOIDES

Coccidioides Stiles in Rixford and Gilchrist, Johns Hopkins Hosp. Rept. **1**: 209-268, 1896.

Posadasia Cantón in Posadas, Psorospermiosis infectante generalisada, Buenos Aires, 1898.

Pseudococcidioides Fonseca in Mazza & Parodi, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **4**: 495-502, *Figs. 13-19*, 1928.

The type species is *Coccidioides immitis* Stiles.

In tissue, mycelium very rare, mostly large, thick-walled cells which become asci and are filled with a large, indefinite number of ellipsoid spores. In cultures, asci rare, mycelium abundant, sometimes approaching raquet mycelium as in *Trichophyton,* forming arthrospores and chlamydospores. Mycelium septate but each cell multinucleate; without sprouting forms on any medium so far observed.

---

*As this goes to press, Ciferri & Redaelli report isogamous conjugation in a freshly isolated culture of *Coccidioides immitis,* although they state apogamy is the rule.

The cytology and synonymy of this genus are very puzzling. As originally described by Stiles, the spore initials and spores are uniformly scattered throughout the ascus. The original descriptions of *Posadasia* by Wernicke and Posadas are essentially similar. Then in a case from the Argentine Chaco, reported by Mazza & Parodi, Fonseca noted that in spore formation, the ascospore nuclei migrated to the peripheral layer of the protoplasm as they do in the Protomycetaceae (Fig. 23) and are separated by radial cleavage planes (Fig. 23, *3*, *4*) followed by periclinal planes until two or three layers of protospores are produced (Fig. 23, *5*, *6*). The protospores then form groups of 2-16 spores, which finally expand and fill the whole central vacuole as they increase in size. Almeida (1932) working with a strain from Omaha, Nebraska, *D. Spring 1091* found a similar condition in the host tissues. Whether this condition exists in all the North American Strains of *Coccidioides* and has been overlooked by North American workers or whether it constitutes a real difference between the North and South American species is still an unsolved problem. Unfortunately apparently none of the Argentine organisms has been cultivated so that we can compare cultural characters. Since *Posadasia esferiformis*, the organism of Wernicke and Posadas, and *Pseudococcidioides Mazzai* of Mazza & Parodi, came from the same region, it is likely that they are identical but different from *Paracoccidioides brasiliensis* with which it was formerly confused by Morris Moore and myself. Much more cultural and cytologic study will be necessary to solve the problems of synonymy presented by this family. Clinically the three groups produce similar lesions.

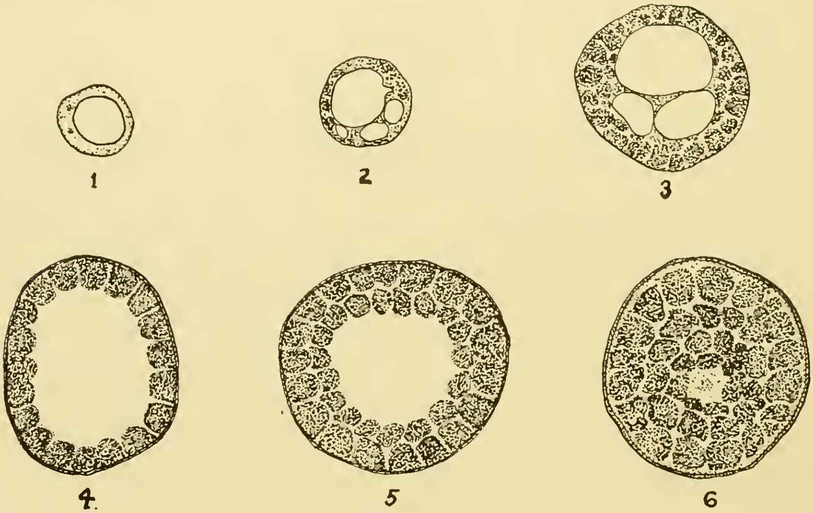

Fig. 23.—*Coccidioides immitis (Pseudococcidioides Mazzai)*, development of asci in tissues. (After Fonseca, in Mazza & Parodi 1928.)

Coccidioides immitis Stiles in Rixford & Gilchrist, Johns Hopkins Hosp. Rept. **1**: 209-268, 1896.

Coccidioides pyogenes Rixford & Gilchrist, Johns Hopkins Hosp. Rept. **1**: 209-268, 1896.

Megalocitosporides Wernicke, Centralbl. Bakt. **12**: 859-861, *Pl. 6,* 1892; Posadas, Tesis, Buenos Aires, 1894.

Coccidium neoplasicum Canton, Tratado de los zooparásitos del cuerpo umano, Buenos Aires, 108-122, 1897.

Posadasia esferiformis Cantón in Posadas, Psorospermiosis infectante generalizada, Buenos Aires, 1898.

Oidium coccidioides Ophüls, Jour. Exp. Med. **6**: 443-485, *Pls. 34-38,* 1905.

?Oidium protozooides Ophüls, Jour. Exp. Med. **6**: 443-485, *Pls. 34-38,* 1905.

Zymonema immitis Froilano de Mello & Fernandes, Arq. Hig. Pat. Exot. **6**: 278-279, 283-284, 1918.

Mycoderma immite Verdun & Mandoul, Précis Parasitol. 769-771, 1924.

Pseudococcidioides Mazzai Fonseca in Mazza & Parodi, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **4**: 495-502, *Figs. 13-19,* 1928.

Coccidioides esferiformis Moore, Ann. Missouri Bot. Gard. **19**: 397-428, 1932.

Not *Blastomycoides immitis* Castellani, Amer. Jour. Trop. Med. **8**: 381, 1928, etc., which is *Geotrichum immite* Agostini (p. 219).

Eight types of lesions have been reported; primary cutaneous or primary pulmonary lesions both with later generalization, primary pulmonary lesions with secondary subcutaneous lesions, primary pelvic involvement, and primary meningeal or spinal cord involvement without any skin lesions; primary joint lesions and primary subcutaneous lesions. It is supposed that the organism enters through the lungs or through skin injuries. The lesions clinically resemble tuberculous or sporotrichotic lesions. Most of the cases seem to have come from the San Joaquin Valley or the southern countries of California. Mortality is at present high, being about 65% of the cases according to a recent estimate.

Hyphae 2-4μ in diameter, giving rise to raquet mycelium and chlamydospores 5 × 11μ. Cells may give rise to arthrospores. Asci 4-80μ in diameter (Fig. 24, *19*), filled with numerous ellipsoid ascospores, up to 2.5μ in diameter (Fig. 24, *1*).

On malt extract agar (pH 5.2) colony creamy white, becoming brown after several weeks, loose, cottony, forming concentric circles, chlamydospores abundant, 4-7μ (Fig. 24, *16, 17*). On Sabouraud agar (pH 5.6) growth rapid, cream color when young, light brown in age, mycelium cottony, hyphae 2.5μ in diameter (Fig. 24, *6, 8*). On glycerol agar (beef extract agar with 6% glycerol) growth abundant, thick at the inoculum, then thinner, surrounded by an elevated plateau, hyphae 2.5-3μ in diameter, hypnospores 7μ in diameter (Fig. 24, *7, 10*). On gelatin, growth conic with loose, cottony, branching, septate mycelium, 2μ in diameter. On Raulin's solution, colony white, filamentous, growing in large flakes, partly submerged in the medium, hyphae only 1μ in diameter, long with few septa, swollen portions 2 × 6μ, with some chlamydospores and arthrospores. In Richard's solution, growth similar to that on Raulin's but more abundant, hyphae more slender. Gelatin liquefied.

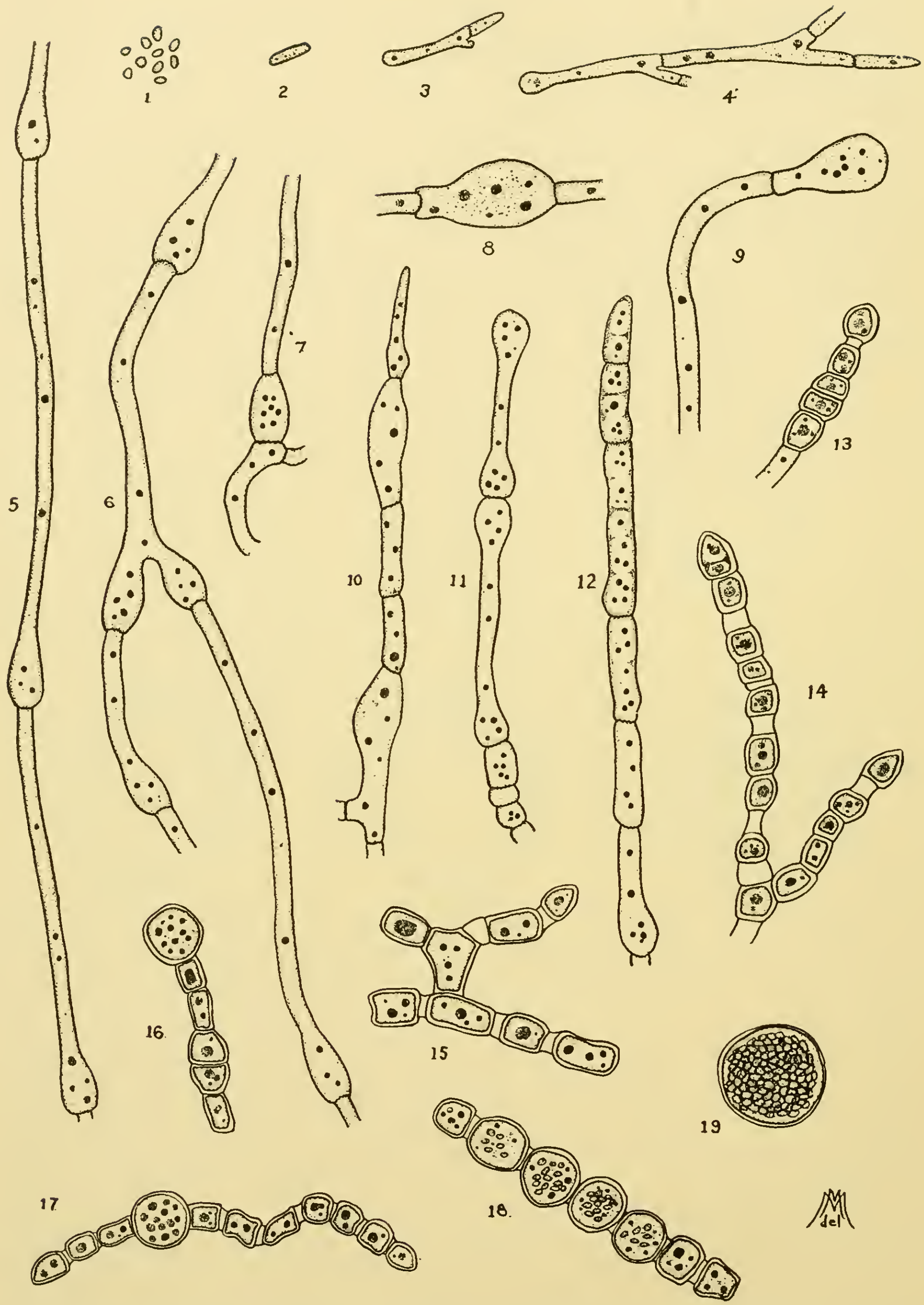

Fig. 24.—*Coccidioides immitis.* *1,* spores; *2-4,* spore germination; *5,* mycelium on nutrient agar; *6,* mycelium on Sabouraud's agar; *7, 10,* mycelium on glycerol agar; *8,* chlamydospore on Sabouraud's agar; *9,* terminal hypnospore; *11-14,* formation *of* arthrospores; *15,* branching arthrospores; *16, 17,* old mycelium with chlamydospores on malt extract agar; *18,* chlamydospores in anaerobic cultures; *19,* ascus. (*1-7, 10-14, 16-19* ×580; *8, 9, 15* ×870.) (After Moore 1932.)

RHINOSPORIDIUM

Rhinosporidium Minchin & Famtham, Quart. Jour. Microscop. Sci. **49**: 521-532, *Pls. 30, 31,* 1905.

The type species is *Rhinosporidium Kinealyi* Minchin & Famtham.

Mycelium unknown, organism not yet cultivated? Reproduction by multispored asci in host tissues. No trace of sexuality observed. Asci opening by a definite pore, spores ellipsoid, with 4-8 enucleate protein granules which have often been mistaken for spores.

Until the organism has been cultivated, its position must remain doubtful. The presence of a thick wall about the spore and the absence of an ameboid or flagellar stage after the emergence of the spore makes its reference to the Archimycetes or Chytridiales seem very doubtful, although the structure enclosing the spores is suggestive of a zoosporangium. It seems rather to belong to the Coccidioideaceae where it was placed by Wernicke.*

Rhinosporidium Seeberi (Wernicke) Seeber, Rhinosporidium Kinealyi et R. Seeberi, une question de priorité, Buenos Aires, 1912.

?Coccidium Seeberi Wernicke, Programa de Zoologia Medica, Univ. Buenos Aires,* 1900 [also cited Wernicke in Seeber, Tesis, Buenos Aires, 1900].

Coccidium Seeberia Wernicke apud Belou, Tratado de Parasitologia 62, 303, 1903.

Rhinosporidium Kinealyi Minchin & Famtham, Quart. Jour. Microscop. Sci. **49**: 521-532, *Pls. 30, 31,* 1905.

Found in polypoid growths where the asci lie between the connective tissue cells; recorded from the nose, nasopharynx, uvula, conjunctiva, lacrimal sac, ear, and penis, cases reported from India, Ceylon, Argentina, and the Mississippi Valley. Noronha (1933) suggests it may be water borne, on account of its extreme prevalence in the fresh-water divers of India.

The cells in the earliest stages are about 6μ in diameter with a chitinous wall, vacuolated cytoplasm, and a vesicular nucleus with a karyosome (Fig. 25, *1*). When the cell reaches a diameter of 50-60μ, mitosis occurs, showing 4 chromosomes (Fig. 25, *2*). Other synchronous mitoses occur with increasing size until the 7th, when the parasite is about 100μ in diameter and has about 128 nuclei. Then the wall becomes greatly thickened with deposits of cellulose except at one point, the future pore (Fig. 25, *3*). At the twelfth synchronous nuclear division (about 4,000 nuclei), divisions in the cytoplasm occur, forming rounded masses which divide twice, to form about 16,000 young spores. The mature spore has a chitinous wall, a vesicular nucleolus with karyosome and cytoplasm in the vacuoles of which are 10-16 refringent spherules, each about 1.5-2μ in diameter (Fig. 25, *4, 5*). The spores are spherical

---

*I have been unable to see the original place of publication of the specific name of *R. Seeberi,* and if it was published before 1903, apparently it was published in an ephemeral manner (Programa de Zoologia Medica 1900) at the university in Buenos Aires. Ashworth was unable to obtain a copy; Seeber (1912) states that it was named *Coccidium Seeberi* in that publication. In the Programa dated 1907, Ashworth states that the name is *Coccidioides Seeberi,* showing that by 1907 Wernicke had concluded that it was congeneric with *Coccidioides.*

or ovoid, 7-9μ in diameter. They are discharged from the ascus (Fig. 25, *6, 7*) by the rupture of the wall where little or no cellulose was deposited, either directly into the nasal cavity (Graham 1932) or into the lymphatics. Mature asci are 200-300μ in diameter, sometimes larger at the surface of the polyp. Spores are spread in the connective tissue by the tracts of lymph exudate, the spherules disappear and the vegetative stage begins by absorption of the fluid in the interstices of the connective tissue, and apparently the cycle is repeated.

Attempts to cultivate it have been unsuccessful, the only case of partial success being that of Rettie, reported by Ashworth, where the spores seemed to elongate to cells 19 × 4.5μ and divide by fission. Contaminating bacteria prevented further work with these cultures, and the author was not even sure that the elongated cells had come from the spores of *Rhinosporidium.*

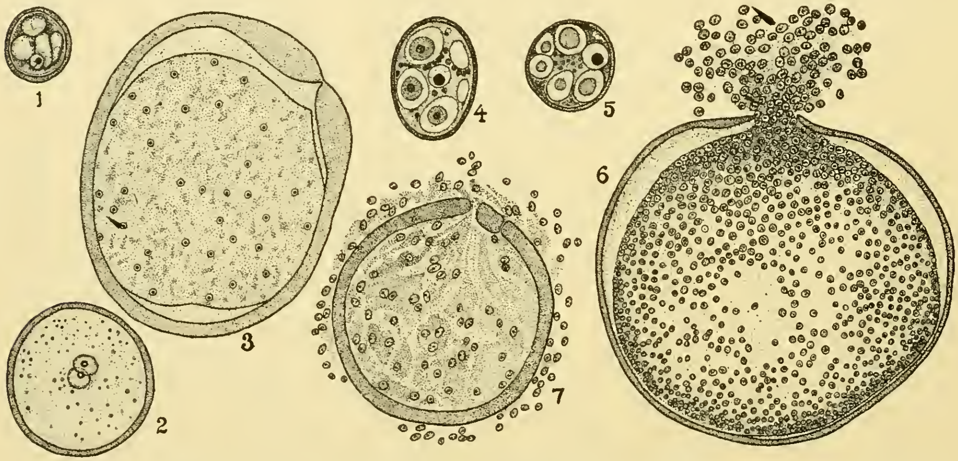

Fig. 25.—*Rhinosporidium Seeberi; 1,* early trophic stage, 12x13μ; *2,* after first nuclear division, about 40μ; *3,* section of stage with about 500 nuclei, showing beginning of spore and annulus; *4,* section of a spore 10×7μ, showing wall, nucleus with karyosome, vacuoles, and refringent spherules; *5,* similar spore with eccentric nucleus; *6, 7,* ruptured asci. (After Ashworth 1923.)

HISTOPLASMA

Histoplasma Darling, Jour. Amer. Med. Assn. **46**: 1283-1285, 1906; Arch. Int. Med. **11**: 107-123, 1908; Jour. Exp. Med. **11**: 515-531, 1909.

The type species is *Histoplasma capsulatum* Darling.

Vegetative mycelium in culture producing chlamydospores and conidia. In tissues existing as yeast cells with thick capsules, invading the mononuclear cells of the blood and the endothelial cells in the smaller lymph and blood vessels and capillaries. In cultures, the hyphae are septate and multinucleate, producing tuberculate asci with many ascospores per ascus. Chlamydospores and conidia are produced on certain media.

This genus seems close to *Paracoccidioides* in general appearance, but the nuclei which will form the ascospores do not migrate into the tubercles on the ascus as reported for *Paracoccidioides* nor are conidia reported in the literature for the latter genus.

So far only two species have been reported, from both the United States and Central America. They produce fatal infections characterized by emaciation, severe anemia with a marked leucopenia, splenomegaly, enlargement of the liver, and irregular pyrexia. The affected organs become necrosed, and the liver develops cirrhosis. The lungs and both small and large intestines are studded with pseudotubercles, giving the appearance of miliary tuberculosis. The peribronchial lymph nodes are enlarged and show ulcerated tubercles.

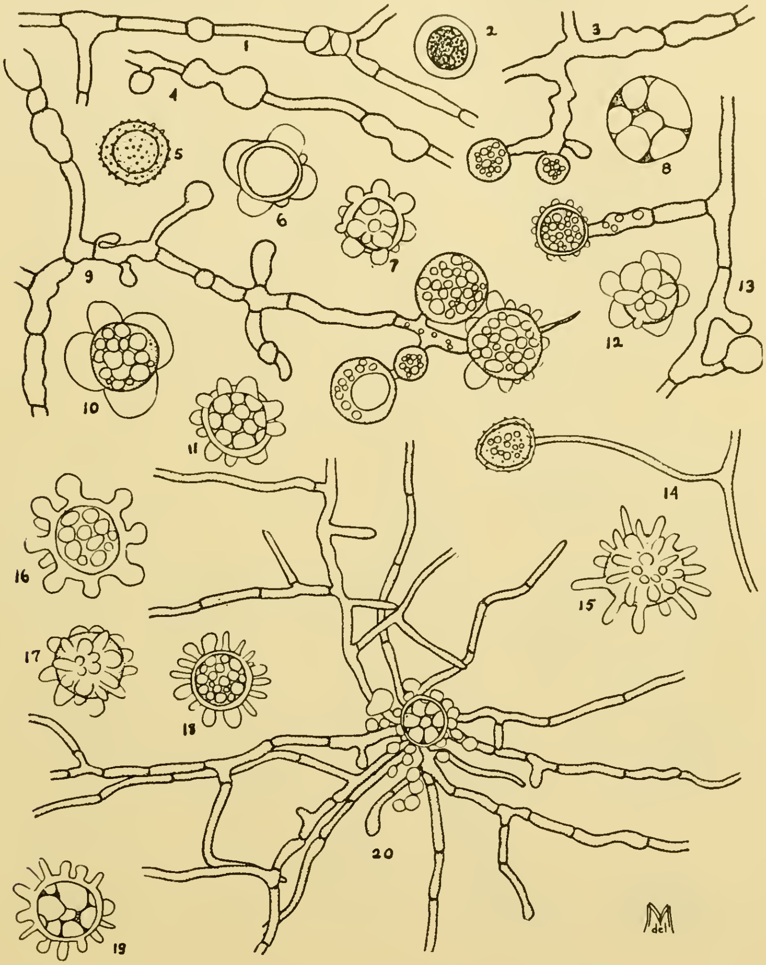

Fig. 26.—*Histoplasma capsulatum.* *1, 3, 4, 9, 13, 14,* mycelium on various media, some showing asci, conidia, and clavate terminal cells; *2,* large cells from submersed mycelium; *5,* young ascus (?); *6, 7, 10-12, 15-17,* spherical tuberculate cells, probably degenerate asci, on various media; *8,* large spherical cell showing vacuoles; *18,* ascus showing oil globules; *19,* ascus showing protoplasmic network and vacuoles; *20,* germinating ascus (?).

Histoplasma capsulatum Darling, Jour. Amer. Med. Assn. **46**: 1283-1285, 1906; Arch. Int. Med. **11**: 107-123, 1908; Jour. Exp. Med. **11**: 515-531, 1909.

Cryptococcus capsulatus Castellani & Chalmers, Man. Trop. Med. ed. 3. 1076, 1918.

Torulopsis capsulata Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Posadasia capsulata Moore, Ann. Missouri Bot. Gard. **21**: 347, 348, 1934.

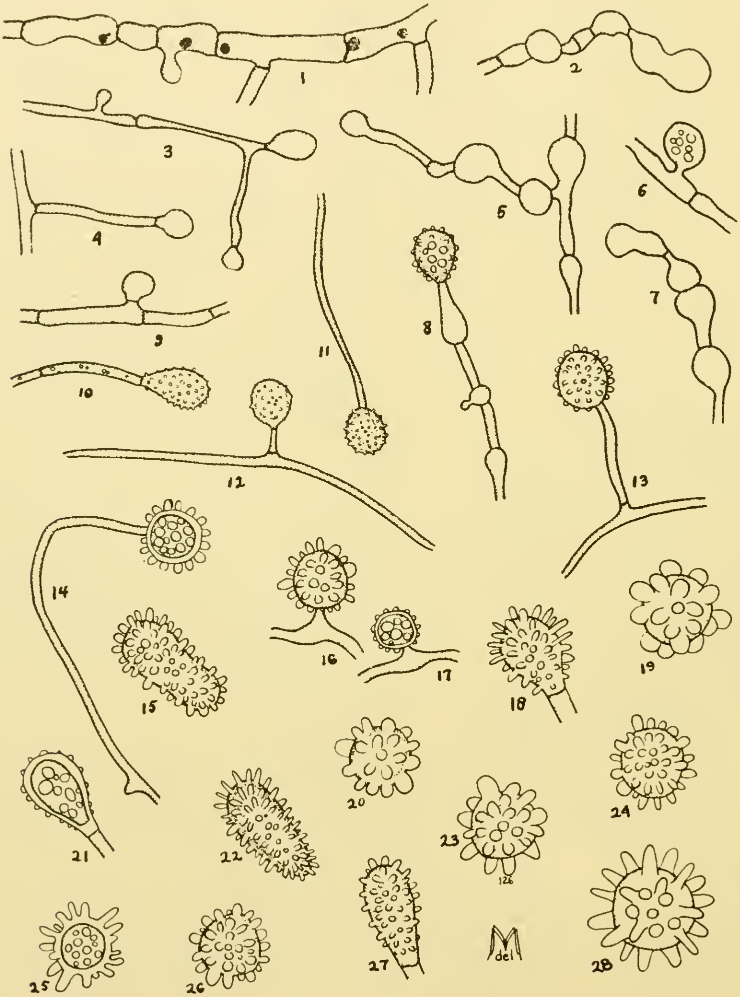

Fig. 27.—*Histoplasma pyriforme.* *1-7,* mycelium showing variation on various media; *8, 10, 11,* terminal tuberculate cells, probably degenerate asci; *9,* conidium; *12, 13,* lateral tuberculate cells; *14-20,* older tuberculate cells showing variation on various media.

First seen in tissues by Darling, first cultures by Monbreun (1934) from case by Dodd & Tompkins (1934), also studied by Moore (1934). Pathogenic to *Macacus rhesus.*

In tissues, cells spherical or ovoid, 1-4 × 3μ, with a thick capsule, budding in the tissues (Rocha Lima, 1912, 1913). This form persists when kept on blood and serum media at 37° C. and transferred at short intervals. In other cultures, hyphae septate, 1-5μ in diameter, multinucleate, sometimes showing raquet mycelium (Fig. 26). Chlamydospores singly or in chains, intercalary or lateral, sessile or pedicellate, 3-10μ in diameter, rarely terminal, then 3-10 × 6-20μ. Conidia lateral, either sessile or pedicellate, spherical to pyriform, 2-8μ in diameter. No trace of sexual organs present. Asci terminal, lateral or intercalary, at first spherical or clavate 5-18μ in diameter, smooth and thick-walled at first, becoming pitted, then spinose and finally tuberculate on aerial mycelium, while those beneath the substrate remain smooth and thick-walled (Fig. 26, *5-19*). The tubercles are very variable, sometimes resembling germ tubes, but so far as known they are functionless. Asci with an indefinite number of spherical spores.

On more acid agars, colonies white, cottony, growth poor, and submersed, asci not observed. On malt extract agar, colony light isabelline, with radial furrows, margin woolly. On Sabouraud agar, colony light isabelline, cottony, suggesting pleomorphic colonies of dermatophytes. On serum agar, colony white, moist, with deep radial furrows and flat margin. Sediment but no pellicle with broth, no fermentation or acid production, litmus milk alkaline without coagulation or digestion, no liquefaction of gelatin.

Histoplasma pyriforme (Moore) Dodge n. comb.

Posadasia pyriformis Moore, Ann. Missouri Bot. Gard. **21**: 347, 348, 1934.

Isolated from histoplasmosis in Iowa by Hansmann & Schenken (1933).

In general morphology close to *H. capsulatum* but asci pyriform, smaller, 6-12 × 12-26μ, usually about 10 × 22μ (Fig. 27).

On more acid agars, growth cottony, white, heaped up in the center. On malt extract agar, colony isabelline, cottony, flat zonate, center elevated to cerebriform. On Sabouraud agar, colony isabelline, zonate, cottony, with a woolly margin. On serum agar, colony cottony, light isabelline, with a flat moist margin. On peptone glucose broth both sediment and pellicle produced; on lactose broth, sediment but no pellicle. No fermentation or acid production in sugars, litmus milk alkaline without coagulation or digestion, no liquefaction of gelatin.

PARACOCCIDIOIDES

Paracoccidioides Almeida, Annaes Fac. Med. São Paulo **5**: [1-19] *9 pls.,* 1930.

Vegetative characters both in tissue and in culture similar to *Coccidioides.* In the tissues of the host, after rapid nuclear division in the ascus, the nuclei migrate to and through the ascus wall, pushing out small ellipsoid to spherical structures which are abjointed as spores. This process, similar to that reported in *Actonia* and suggestive of conditions in *Protomyces,* is quite reminiscent of the formation of partial sporangia in the higher Mucoraceae (see pp. 102, 103). Ascus formation has not yet been observed in vitro.

This tendency for the formation of spores outside the ascus seems not to have developed further in this family, although in the Protomycetaceae, in *Protomyces* the whole protoplasm of the ascus migrates into a large saccate protuberance and develops its spores there, after the return to suitable conditions of the environment.

Paracoccidioides brasiliensis (Splendore) Almeida, Annaes Fac. Med. São Paulo **5**: [1-19], *9 pls.,* 1930.

Zymonema brasiliensis Splendore, Bull. Soc. Path. Exot. **5**: 313-319, 1912.

Coccidioides brasiliensis Almeida, Annaes Fac. Med. São Paulo **4**: 91-98, *4 pls.,* 1929.

Monilia brasiliensis Vuillemin, Champ. Paras. Homme 86, 1931

Apparently this species gains entrance into the host usually through the digestive tract, while *Coccidioides immitis* enters through the lungs; both may enter through wounds of the skin. *P. brasiliensis* is abundant in the lymphatics and rare in bone and lungs, while *C. immitis* is rare in the lymphatics and unknown in the intestines, but common in the bones and lungs. Positive inoculations of experimental animals are obtained with difficulty except in the testicles, where only local lesions are observed.

Sprout cells in the tissues, spherical up to 40μ, developing into asci which bud out spores about the periphery until the dense protoplasm is used up.

Cultures obtained with difficulty. On Sabouraud agar, colonies white or gray, cottony like pleomorphic mycelium of dermatophytes, growth very slow. In broth and simple agar (pH 7.4) spherical forms similar to those found in tissues forming a yellowish, wrinkled, cerebriform colony (resembling that of *Achorion Schoenleini*).

This species differs from *Coccidioides immitis* in the smaller asci, different method of spore discharge, and difficulty of culture and animal inoculation.

Doubtful Position

Neogeotrichum O. Magalhães, Mem. Inst. Oswaldo Cruz **26**: 151-167, *Pls. 36-40,* 1932.

The type species is *Oidium pulmoneum* O. Magalhães non aliorum.

Mycelium hyaline, septate, branches terminating in arthrospores or blastospores, fine, delicate, about 1μ in diameter, irregular or without septa; bacillary forms developing in special cysts; large asci as in *Coccidioides* which finally discharge their spores as in *Paracoccidioides,* colonies cerebriform, dry, or spinulose and moist; forming a pellicle on liquid media, fermenting sugars; liquefying gelatin.

I wish that the life cycle of this very curious organism were more fully described. One is almost inclined to think it may be based upon two organisms, one *Paracoccidioides* or a very closely related species, the other *Actinomyces.* Even with this the curious bacilliform cells borne in cysts are difficult to explain. Can they be gametes similar to those of *Spermophthora* or are they an artefact or contamination? The genus must remain of doubtful position until single cell isolations are made and the life cycle traced through in great detail. Evidently it is not closely related to *Geotrichum* or the imperfect Eremascaceae.

Neogeotrichum pulmoneum (O. Magalhães) O. Magalhães, Mem. Inst. Oswaldo Cruz. **26**: 151-167, *Pls. 36-40,* 1932.

Oidium pulmoneum O. Magalhães, Brasil Med. **28**: 313, 1914.

Oidium brasiliense O. Magalhães, Mem. Inst. Oswaldo Cruz. **10**: 20-61, *11 pls.,* 1918; *Ibid.* **19**: 290, 291, 1926.

Mycoderma brasiliense Neveu Lemaire, Précis Parasitol. Hum. 69, 1921.

Monilia brasiliensis Brumpt, Précis Parasitol. ed. 3, 1100, 1922.

Myceloblastanon brasiliense Ota, Jap. J. Derm. Urol. **28**: [4 Japanese] 1928.

Geotrichum brasiliense Ciferri & Redaelli, Ann. Myc. **27**: 243-295, 1929.

Candida brasiliensis Basgal, Contr. Estudo Blastomycoses pulmonares 50, 1931.

Case with the usual symptoms of pulmonary tuberculosis. *Mycobacterium tuberculosis* not found by any method. *Neogeotrichum* inoculated into monkeys, reproduced the human disease very closely, and the organism was reisolated. Severe lesions caused in the usual laboratory animals. Full clinical, pathologic, and therapeutic notes given.

At first yeast forms prevail, 5-6μ in diameter. These also are the principal forms found in sputum. Mycelium abundant on carrot and potato, septate, septa disappearing in old cultures. Spores or cysts form bacilliform bodies, rupture, set free spores, and thus reproduce.

Colonies moist at first, becoming dry and velvety, wrinkled to almost cerebriform, dirty gray or whitish (dirty yellow on carrot). Growth good on Sabouraud agar with maltose and alkaline Sabouraud agar, potato slices, carrot, Drigalski-Conradi, Endo, Gorodkova, Loeffler media; milk coagulated 6-12 days, gelatin liquefied 12-14 days with thick dark brown pellicle, glycerol-gelatin liquefied within 30 days. In simple broth a pellicle, dark gray, thick, no clouding but after several months a brownish white sediment forms, containing both yeast cells and mycelium. Growth even better in glycerol broth. No fermentation. Acid with sucrose, galactose, nutrose, mannite, fructose, raffinose, dextrin.

Protomycetaceae.—This family continues the main line of development from the Coccidioideaceae, with the migration of the ascus nuclei to the wall before spore formation begins. The spore mother cell initials are separated by radial planes of fission and then by periclinal fissures. These then divide into four spores and form a wall, suggestive of conditions found in the protospores of the Mucoraceae and in some other groups. There are two well-known genera of obligate parasites of plants, *Protomyces* and *Taphridium.*

In *Protomyces pachydermus* on dandelion *(Taraxacum officinale)* and *P. macrosporus* on various members of the parsnip family (Umbelliferae) causing various small hypertrophies on stems and leaves of the host, conditions are essentially similar to those in *Coccidioides* reported by Fonseca (1928), but the need for a resting spore to carry the fungus over unfavorable environmental conditions has caused a further development of the ascus. In some cases paired nuclei have been seen in the young asci. These thick-walled asci winter in the host. In spring, the outer layers of the ascus wall rupture and the inner wall swells out as a cylindric or spherical sac (Fig. 28, *2*). The vacuoles fuse to a large central vacuole and the protoplasm lines the wall as a homogeneous layer (Fig. 28, *3*). Probably nuclear divisions take place in it. By radial fissures, the wall layer is divided into uninucleate portions (spore mother cells) which, after two simultaneous divisions separate into four spores each (Fig. 28, *4-7*). At the top of the sporangium, these gradually form a ball which is forcibly ejected a short distance (Fig. 28, *8-10*).

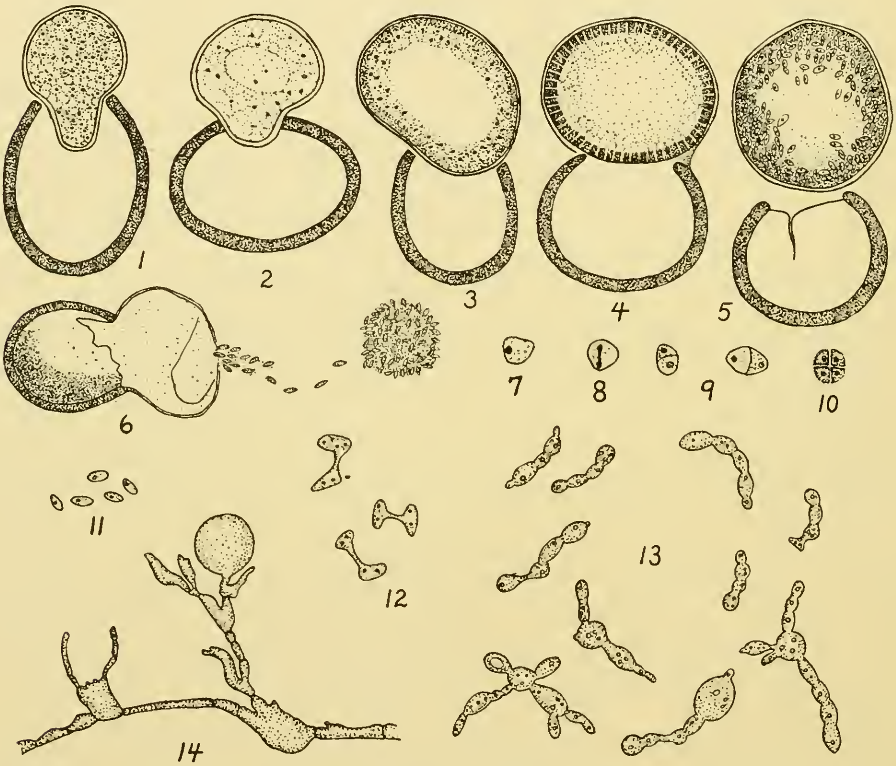

Fig. 28.—*Protomyces macrosporus.* *1-6,* germination of hypnospores; *7-11,* development of ascospores; *12, 13,* copulation and development of ascospores, young hypha with hypnospores. (*1-6, 11, 13* ×300; *7-10* ×1,500; *12* ×660; *14* ×170.) (After Büren 1915.)

The spores are ellipsoid, hyaline, and uninucleate. Directly after they are ejected from the sporangium, they are connected by small processes and copulate (Fig. 28, *11, 12*). The nuclei enter the copulation bridge, but whether they fuse or merely join in pairs to form a dicaryon is not yet ascertained, on account of great difficulties in technic. In nutrient solutions they form pseudomycelia only. When the spores reach a new host, they penetrate between the epidermal cells and produce a normal mycelium. In *Protomyces inundatus,* on celery, during the summer, the young asci may germinate directly without going through the resting stage, but here the ascus wall is not thickened, and there is no migration of the protoplasm out of the old ascus wall. However, the asci produced on the approach of cold weather have the thickened wall and germinate the following spring as in *P. macrosporus* (Dangeard 1906, Büren 1918).

In the second genus, *Taphridium* (*Volkartia*), the asci are not scattered irregularly throughout the host tissue but form a continuous layer just under the epidermis, suggesting the beginning of ascocarp formation, protecting the young asci by a layer of host tissue. Germination is immediate, the fungus being carried over the winter by the mycelium in the roots. This line of ascocarp formation finds fuller expression in the next family.

Taphrinaceae.—(Exoascaceae of many earlier writers.) This family is strictly parasitic on flowering plants, but a discussion is included here to show the culmination of the line of development through the Coccidioideaceae and Protomycetaceae and because several of the earlier writers incorrectly referred organisms to this group (e.g., the term *exoascoses* frequent in French texts before the war). Also, this family is the only one of the group whose cytology has been studied carefully. A knowledge of this cytology may prove suggestive in what to expect in the other families, although one should be extremely careful in assuming a similarity between different families of an order.

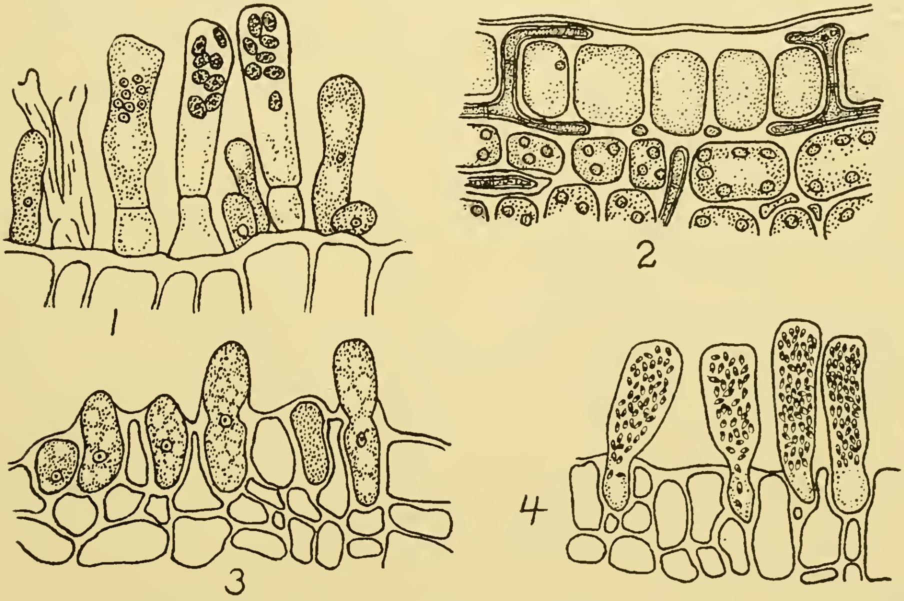

Fig. 29.—*Taphrina deformans.* *1*, hymenium; *2*, intercellular mycelium. *Taphrina aurea.* *3*, young hymenium; *4*, mature hymenium. (*1* ×670; *2* ×600; *3*, *4* ×330.) (After Sadebeck 1884 and Gwynne Vaughan 1922.)

In *Taphrina deformans*, the peach leaf-curl (Dangeard 1894, 1896, Eftimiu 1927, Fitzpatrick 1934). The sprout mycelium winters over in the bark and its cells are washed into the opening leaf buds in the spring. The germ tube penetrates the young leaf and the resulting mycelium becomes binucleate in some unknown manner. It stimulates the unfolding leaves to unequal growth by hypertrophy, causing the characteristic curling. The hyphae force their way between the cells of the upper epidermis and form a reticulate tissue between the epidermis and cuticle (Fig. 29, *2*). The individual cells swell during nuclear fusion, thicken their walls, and form a compact layer of chlamydospores capable of immediate germination. The exospore is ruptured, and the endospore with the protoplasm bulges out as a papilla rupturing the cuticle. When the chlamydospores are entirely empty, the protoplasmic portion is abjointed from the empty portion. This apical cell forms the young ascus; and the empty cell is called the stipe cell.

The young ascus contains a large diploid nucleus formed by the fusion of two hyphal nuclei during the formation of the chlamydospore. This nucleus divides thrice. In the first division meiosis occurs. The protoplasm is in the peripheral layer, which is denser near the nucleus. The developing spores lie embedded in the meager periplasm (Fig. 29, *1*). Under suitable conditions of moisture and substrate, they lead a saprophytic existence, developing sprout cells like the yeasts; occasionally sprouting begins within the ascus. In certain species, young, still sporeless asci may develop vegetatively either to hyphae or sprout mycelia.

The chlamydospores may be interpreted as zeugites, organs in which at the close of the dicaryophase, caryogamy occurs. The position of plasmogamy in the life cycle is still unknown.

In general the other Taphrinaceae follow the development of *Taphrina deformans.* In *T. epiphylla* and in *T. Klebahni,* Wieben (1927) has reported copulation of blastospores prior to the formation of ineffective germ tubes, which are then binucleate. In *T. bullata,* on pears and quinces, several dicaryons (instead of one) are present in the hyphae but the mycelium becomes binucleate before spore formation. In *T. aurea* (Fig. 29, *3, 4*) on *Populus* (poplar) and in *T. epiphylla* on *Alnus* (alder), there is no formation of a stipe cell. In *T. Coryli* on *Corylus* (hazel) the diploid nucleus divides into two daughter nuclei in the chlamydospore. One remains in the basal cell and degenerates, the other migrates into the young ascus and divides there into 8 spore nuclei (Martin 1924).

CHAPTER X

ENDOMYCETALES—EREMASCACEAE

The principal line of development from a primitive form like *Dipodascus*, has continued through the Eremascaceae to the Saccharomycetaceae, both of which are probably very large families. Very few saprophytes have yet been described in the Eremascaceae and not many more among the animal parasites of this family, but there is a huge number of rather poorly described Fungi Imperfecti which probably will be found to belong to these families.

Eremascaceae.—This family includes a few saprophytes on fruit juices and several animal pathogens. Several of the genera have been poorly described and apparently have not been recognized since their original publication.

One of the primitive types is that of *Eremascus fertilis* on fruit juices (Stoppel 1907, Guillermond 1909). The hyphae are often branched and consist of long, narrow cells which are multinucleate (up to 15) in the vicinity of the growing tip (Fig. 30, *1*). In the older portions of the hyphae the cells are uninucleate. About 5 days after transfer, two cells form copulation branches in the region of their septa (Fig. 30, *2*). The copulation branches do not always arise simultaneously, and their length is often unequal; also both processes may not arise from neighboring cells but from cells separated by a small intermediate sterile cell. If they are not too short, they make a half to a complete turn about each other. Those of *Eremascus albus* coil helically (Fig. 31).

When the tips touch, the walls at the point of contact are dissolved, and the two cells fuse. The nucleus of the hyphal cell divides, one daughter nucleus remaining behind in the hyphal cell, the other migrating into one copulation branch where it fuses with the nucleus of the other branch (Fig. 30, *4-8*). The zygote in the bend of the copulation bridge swells up to form an ascus which is abjointed from both copulation branches; its nucleus divides thrice with the formation of 8 spores (Fig. 30, *9, 10*), some of which occasionally degenerate. Those remaining are liberated by disintegration of the asci. At germination the spores swell to twice their former size, rupture the exospore to form one or more germ tubes which, after repeated nuclear division, develop to hyphae.

Besides this normal development, occasional cases of parthenogenesis occur; two copulation branches may swell to asci without fusion. A copulation branch which fails to find a mate may develop parthenogenetically (Fig. 30, *10*). In old cultures even the hyphal cells, though they earlier may have put forth copulation branches, swell up parthenogenetically and form asci, generally smaller than the diploid, but like the latter may have 8 spores, some possibly aborted (Fig. 30, *11-14*).

In *Zymonema capsulatum* (Fig. 32) causing meningitis in man, the hyphae are generally uninucleate, and easily break up into oidia, being usually found as single cells in the spinal fluid and in tissue. When first isolated and on acid media this species has coarse isodiametric cells suggesting *Madurella*. Later, and on neutral protein media, hyphae develop readily. Conidia are produced on these hyphae. The hyphae develop by an outgrowth of the oidia rather than by the elongation of the latter.

Copulation is usually heterogamous, with less differentiation than in *Endomyces* and usually without coiling of the antheridium. The asci are terminal on filaments arising from the ascogonium and usually produce 8 ascospores. In *Zymonema dermatitidis* (Fig. 33) conditions are essentially similar. These species have retained traces of the ascogenous hypha of the Spermophthoraceae, and have developed an ascogonium by the copulation of undifferentiated gametangia, a structure characteristic of most higher Ascomycetes. These species are suggestive of the Spermophthoraceae, where the ascogenous hyphae result from the zygote, but in this family the gametangia fail to develop the gametes and whole gametangia copulate, producing a large zygote. Usually only one nucleus migrates and fuses with a nucleus in the other cell. The zygote nucleus divides,

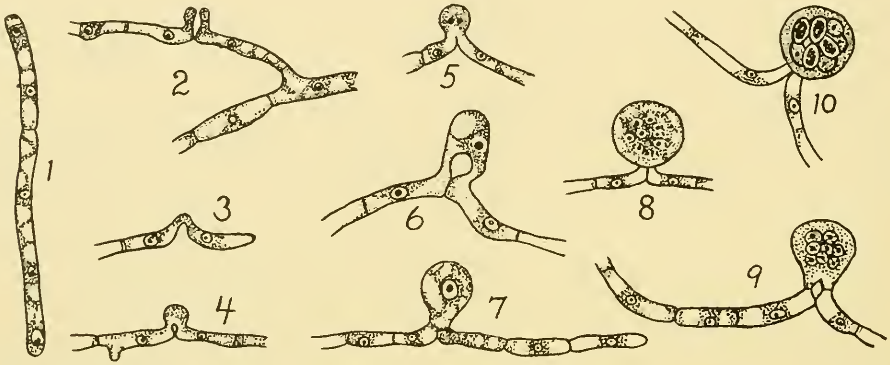

Fig. 30.—*Eremascus fertilis.* Development of asci (×500). (After Guilliermond 1909.)

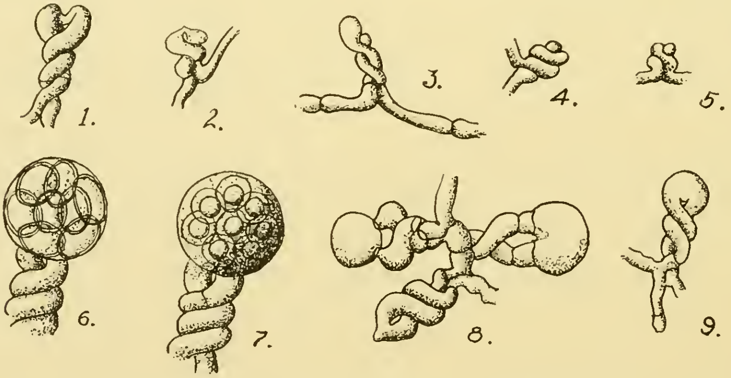

Fig. 31.—*Eremascus albus.* *1-5, 8, 9,* stages of copulation and development of asci; *6,* young ascus with immature ascospores; *7,* mature ascus with ascospores. (After Eidam 1883.)

and the nuclei pass into the ascogenous hyphae. The nuclei are so small and technical difficulties so great that it has been impossible to count the chromosomes, but probably reduction occurs in the ascus.

In *Oleina* (Fig. 34) apparently all traces of sexuality have vanished, although still 8 spores are produced. The presence of raqnet mycelium is vaguely suggestive of conditions found in *Zymonema* and in the dermatophytes. *Octomyces* represents a further step in degeneration, as sprout mycelium is frequently produced.

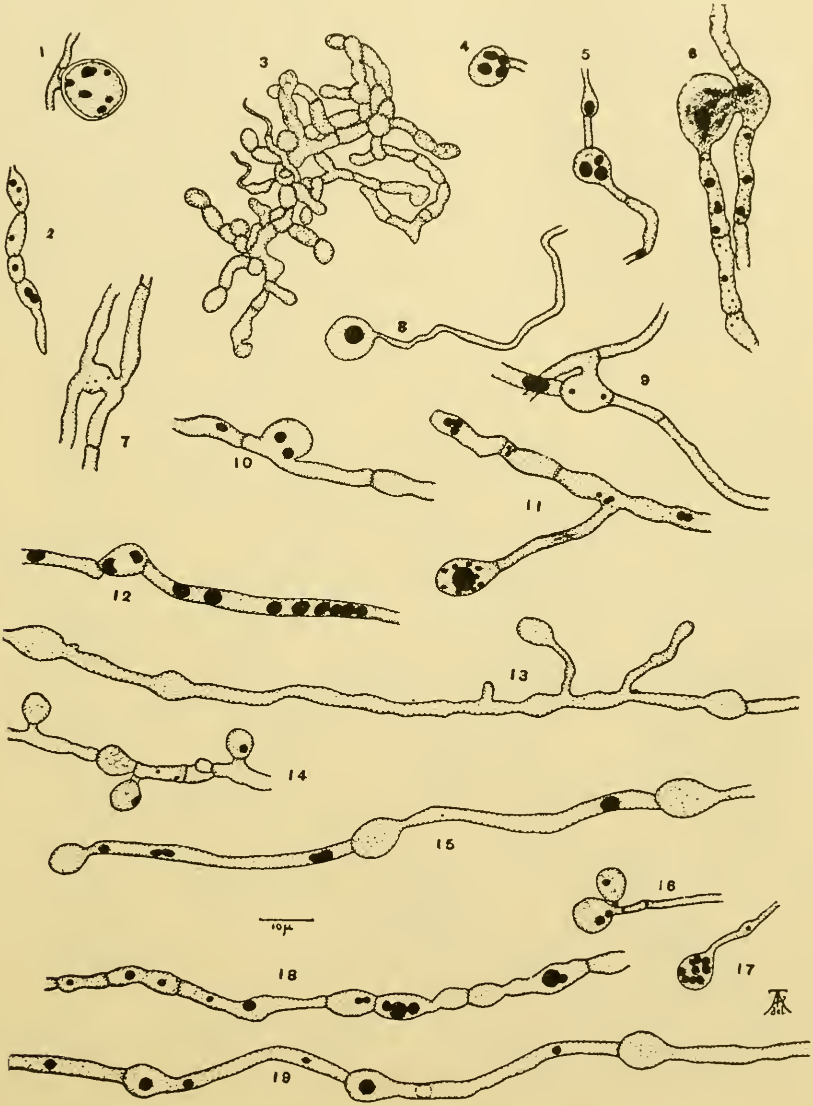

Fig. 32.—*Zymonema capsulatum.* *1,* chlamydospore, corn meal agar; *2,* hypha on Sabouraud's agar; *3,* mycelium on malt extract agar; *4, 8, 17,* asci; *5,* racquet mycelium; *6, 7, 9,* heterogamous copulation; *11,* terminal hypnospore; *12, 13, 15, 18, 19,* mycelium; *14, 16,* conidia. (×1,100.) (After Rewbridge, Dodge & Ayers 1929.)

There is also a group of species, regularly with 4 spores per ascus, which was originally described in *Endomyces* but which apparently is much more closely related to this group. Practically nothing is known of their cytology and life history. Until more is known, I have thought best to leave them in *Zymonema.*

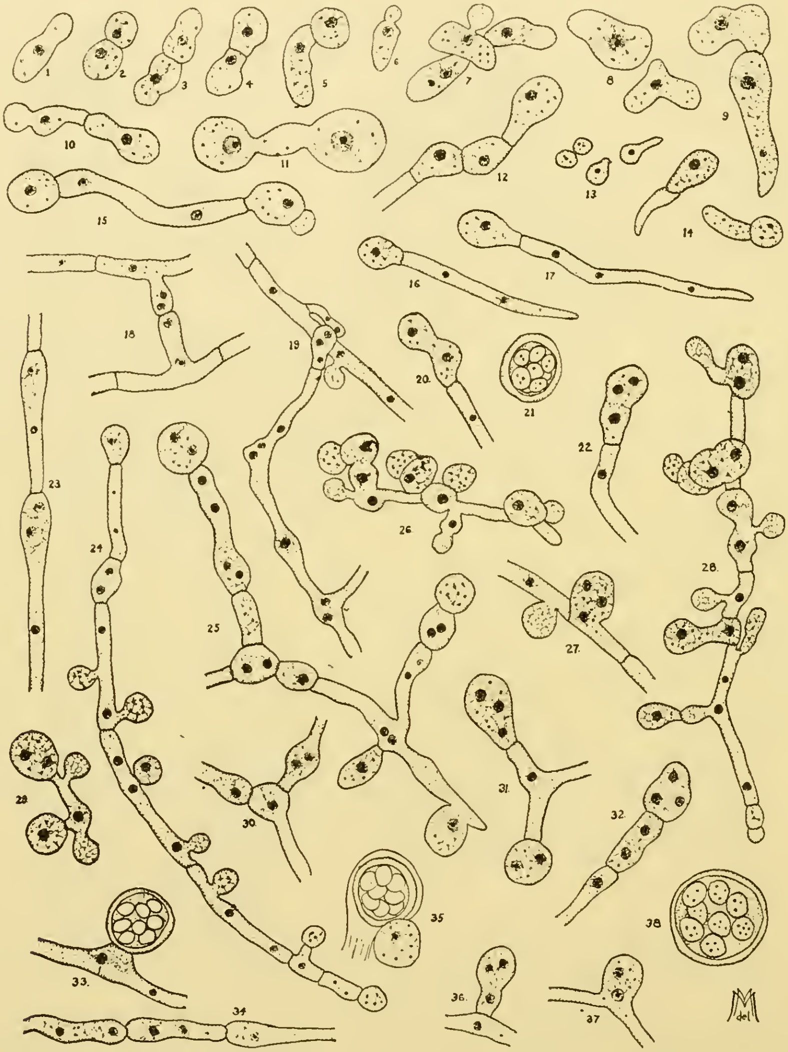
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
M del

Fig. 33.—*Zymonema dermatitidis.* (After Moore 1933.)

In the problematical *Bargellinia,* from the external auditory conduit, the ascus is thick-walled, and the ascospores are reduced to 1 or 2 per ascus. In *Hemispora,* the ascus wall is thin and a single echinulate ascospore is produced in each ascus. It seems probable that this group has given rise to the rough-spored genera of the Saccharomycetaceae, such as *Nadsonia* and *Debaryomyces,* with heterogamous copulation, although in *Hemispora* itself sexuality has apparently been lost.

Key to Genera

Asci formed by copulation at the tip of two coiled copulation branches. *Eremascus.*

Asci formed by heterogamous copulation of two straight copulation branches, or rarely parthenogenetic. *Zymonema.*

Asci developed without traces of copulation.
  Spores usually 4-8 per ascus; ascus thin-walled.
    No sprout mycelium normally present, raquet mycelium present. *Oleina.*
    Sprout mycelium present, no raquet mycelium. *Octomyces.*
  Spores usually 1-2 per ascus.
    Asci solitary, thick-walled; ascospores thin-walled, smooth. *Bargellinia.*
    Asci in chains, thin-walled; ascospores echinulate. *Hemispora.*

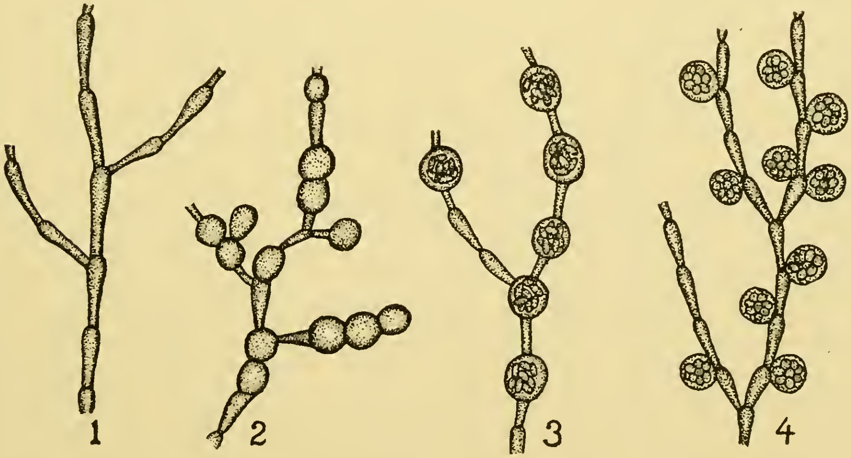

Fig. 34.—*Oleina nodosa* Tiegh. *1,* racquet mycelium; *2,* chlamydospores; *3,* intercalary asci with ellipsoid spores; *4, Oleina lateralis* with sessile lateral asci. (After Van Tieghem 1887.)

ZYMONEMA

Zymonema Beurmann & Gougerot, Tribune Méd. **42**: 503, 1909.

Blastomycoides Castellani, Amer. Jour. Trop. Med. **8**: 381, 1928; Proc. R. Soc. Med. **21**: 451, 1928-1929; Amer. Med. **23**: 290, 291, 1928, pro parte.

Gilchristia Redaelli & Ciferri, Jour. Trop. Med. Hyg. **37**: 280-282, 1934.

Endomyces Auct. non Reess.

The type species is here considered as *Blastomyces dermatitidis* Gilchrist & Stokes [for further discussion see p. 199].

Castellani proposed his new genus, *Blastomycoides,* without designating a type, placing *Coccidioides immitis* and *Blastomyces dermatitidis* in the genus and subsequently added several other equally discordant elements. Since *Coc-*

cidioides immitis is already the type of the genus *Coccidioides* if that species were to be considered the type, it is evident that *Blastomycoides* would fall into complete synonymy as a stillborn name, a situation wholly inconsonant with Castellani's work, since it is evident from his *Manual of Tropical Medicine* that he knew that *Coccidioides immitis* was the type of *Coccidioides.* A further study of *Blastomycoides immitis* Cast. shows that it differs in important respects from *Coccidioides immitis* of the older authors and belongs in *Geotrichum.* Consequently, we prefer to consider *B. dermatitidis* as his type, but even so, the name falls into synonymy with *Zymonema.*

The description of *Zymonema* has been emended to include the more recent knowledge of the life cycle of this organism, obtained by Moore (1933) in my laboratory.

Mycelium and sprout mycelium both present, the asci arising from copulation branches, often heterogamous, rarely parthenogenetic; asci typically ovoid or spherical, spores 4-8 per ascus, smooth, ellipsoid to spherical. In the tissues, yeast cells predominate.

This group is probably much larger than here presented, but the present state of our knowledge regarding the large number of species commonly referred to *Monilia* by the medical man is such that we have not included them here. (See Chapter XI.)

It is possible that a further knowledge of the group will cause a separation of the species into two or more genera. For the most part they embrace species previously referred to *Endomyces* (in the broader sense including the segregate *Endomycopsis*). They differ from *Endomyces* by the shape of ascospore, habitat, parasitism, etc.

- Asci 8-spored, following heterogamous copulation, gelatin liquefied after 30 days.
  - Colony creamy, moist, then covered with coremia ("prickly appearance") and finally cottony. *Z. dermatitidis.*
  - Colony creamy, moist, then cottony. *Z. capsulatum.*
- Asci 2-4-spored, sexuality not reported (perhaps not belonging in *Zymonema*).
  - Not growing well on ordinary media when first isolated, confined to the Equidae. *Z. farciminosum.*
  - Growing well on ordinary media, reported from primates and inoculable to other mammals.
    - Colony crateriform, yellowish or white.
      - Gelatin not liquefied (asci rarely 8-spored). *Z. Molardi.*
      - Gelatin liquefied, colony becoming crackled. *Z. crateriforme.*
    - Colony not crateriform, creamy.
      - Not producing pellicle on liquid media.
        - Sugars fermented, gelatin liquefied, from thrush. *Z. albicans.*
        - Sugars not fermented, gelatin not liquefied.
          - No acid on any sugar. *Z. bonaerense.*
          - Acid in sucrose. *Z. album.*
          - No acid in sucrose. *Z. bucale.*
      - Producing pellicle on liquid media.
        - Glucose, maltose, and sucrose fermented. *Z. Cruzi.*
        - Sugars not fermented, gelatin not liquefied. *Z. Alvarezsotoi.*

Zymonema capsulatum (Dodge & Ayers) Dodge, n. comb.

Endomyces capsulatus Dodge & Ayers in Rewbridge, Dodge & Ayers, Am. Jour. Path. **5**: 349-364, *Pls. 71-73,* 1929.

Isolated from granular, flesh-colored nodule on the surface of the medulla in a case diagnosed as meningoencephalitis with a complicating pulmonary tuberculosis. On postmortem examination the lower surface of the cerebellum, pons, medulla, and cranial nerves, also an old scar on left thigh, were found to be covered with these nodules of mycotic origin. Spinal fluid not involved. Not fatal to rabbits and guinea pigs. Intraperitoneal injection into mice fatal in 3-4 weeks.

In lesions, mycelium exclusively budding cells. In new cultures and acid media, mycelium consists of thin-walled hyphae, 3.5-4μ in diameter, cells nearly isodiametric (Fig. 32, *3*). Hyphae often somewhat contorted. On neutral, high protein media, hyphae, branched, 1.4-1.5μ in diameter, cells long, mostly 2-5 nucleate (Fig. 32, *11, 18*). Sprout cells, 3.5-5μ, abundant on acid media, absent on neutral. Chlamydospores, terminal on short branches or in chains (Fig. 32, *1*), develop from raquet mycelium. Mycelial cells 2.6-3μ in diameter with diameter of 6.5-7μ at swollen end. On corn meal agar, large spherical cells, 11.3μ in diameter develop on the ends of short branches; walls thick but contents appear degenerating. Conidia sessile, pyriform, 5.5-6.5μ, developing irregularly along mycelium, usually near septum. Most abundant on neutral media with protein nitrogen. "Endospores" ellipsoid, 2.6-3.2μ, on the hyphae in Sabouraud glucose agar, formed by rounding up protoplasts, no spore wall observed, deeply staining. Copulation heterogamous (Fig. 32, *6*). A cell of a filament swells to 11μ in diameter, fuses with an apparently little differentiated cell (4.8μ) on a hypha (3.6μ) nearby. Asci found in cultures on Sabouraud glucose agar about nineteen weeks old. Asci terminal on long filaments, 8-spored, subspheric, 7 × 9μ (Fig. 32, *4, 8, 17*). Ascospores hyaline, spherical, smooth, 2μ in diameter.

On wort agar (bacto, pH 4.5), there was no growth. On wort agar (pH slightly higher), surface of colony moist, shining, yeastlike at first, becoming dull or powdery in age. Growth slow, less than 1 cm. in 6 weeks, elevated, convolute to cerebriform, mycelium very irregularly branching, septate, cells short. Not much change after 5 months. On malt extract agar (bacto, pH about 4.7), growth slow, scarcely covering surface in 19 weeks, compact thin felt on older portion, sparse or fine powdery surface on younger portion. Mycelium more filamentous than in wort agar, very few yeast cells. On Sabouraud dextrose agar (bacto pH 4.74) and Sabouraud's conservation agar, growth more rapid, colony 2 cm. in diameter in 2 weeks, white, well-developed at inoculum, surrounded by loose, cottony zone with dense, cottony periphery. Mycelium filamentous, hyaline, branched, composed of clavate cells, 2-4.5μ in short diameter. Hyphal tips swollen. On corn meal agar, growth similar to that on Sabouraud's agar, less developed and slower, mycelium very slender, cells very long. Thick-walled, hypnospores abundant. On beef agar (bacto nutrient pH 7.2), growth rapid, forming a smooth felt over whole surface. Mycelium slender, conidia abundant.

Zymonema dermatitidis (Gilchrist & Stokes) Dodge, n. comb.

Blastomyces dermatitidis Gilchrist & Stokes, Jour. Exp. Med. **3**: 53-78, *Pls. 4-8,* 1898.

Oidium dermatitidis Ricketts, Jour. Med. Res. **6**: 373-547, *Pls. 22-33,* 1901.

Cryptococcus Gilchristi Vuillemin apud Gedoelst, Champ. Paras. Homme 45, 1902.

Zymonema Gilchristi Beurmann & Gougerot, Les Nouvelles Mycoses 34, 1909.

Cryptococcus dermatitidis Brumpt, Précis Parasitol.? 1910; Castellani & Chalmers, Man. Trop. Med. ed 2, 769, 1913.

Mycoderma Gilchristi Jannin, Les Mycoderma 248-253, 1913.

Mycoderma dermatitidis Brumpt, Précis Parasitol.? ed. 3, 1922; ed. 4, 1213, 1927.

Blastomycoides dermatitidis Castellani, Amer. Med. **23**: 291-292, 1928; Amer. Jour. Trop. Med. **8**: 383-385, 1928.

Geotrichum dermatitidis Basgal, Contr. Estudo Blastomicoses pulmonares 29, 1931.

Endomyces dermatitidis Moore, Ann. Missouri Bot. Gard. **20**: 49-118, *Pls. 6, 7,* 1933.

Torulopsis dermatitidis Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Gilchristia dermatitidis Redaelli & Ciferri, Jour. Trop. Med. Hyg. **37**: 280-282, 1934.

Producing generalized blastomycosis as well as cutaneous lesions (abscesses and ulcers). In about a tenth of the cases no lesions are noted on the skin.

In tissues large cells, ovoid or spherical, 8-10-20μ, membrane 3μ thick, sprouting, often with a large central vacuole in old cells. Lower oxygen pressure, lower temperature, and drying of the medium favor the production of hyphae, which are 3-5μ in diameter. Both terminal and lateral conidia, 6-8μ, are borne on short sterigmata.

Colonies on solid media humid, dirty white to chestnut, somewhat translucent and gelatinous in appearance, irregular, compact, elevated, rugose or vermicular, adherent to the substrate and in age dry, with an outer layer of ashy aerial hyphae. On glycerol agar, colonies grayish white, becoming opaque, radiate. On potato, thick, white, resembling the skin of a white mouse. Gelatin not liquefied, milk not coagulated. On sugar broths, no pellicle, no fermentation, producing a granular ashy sediment in 12 days.

The following description is based upon that of Moore (1933).

In the tissues, cells spherical or ovoid, sprouting, 7-12μ rarely up to 20μ, either singly or in small groups. The protoplasm is reticulated, granular, and often vacuolated, with a nucleus. The cell wall is thick and highly refractile, giving the appearance of a double contour. This thick capsular wall is soon lost on cultivation. The hyphae on acid agar are 2-2.5μ in diameter, on neutral or slightly alkaline agar with protein nitrogen the hyphae are thicker, 3-4μ. Sprout cells about 5μ in diameter. The hyphae bear pyriform conidia, about 5μ in diameter, on short sterigmata. Raquet mycelium, with cells 5-6μ in the swollen portion, tapering to 3-3.5μ. Chlamydospores terminal or intercalary, variable in size and shape, spherical, 7-8.5μ in diameter, to ellipsoid cells, 5.5-7.5 × 12-15μ. Two terminal cells of hyphae may copulate or two copulation branches from parallel hyphae may fuse. The resulting ascus is spherical and may be terminal on a long filament or lateral on a short pedicel and is sometimes thick-walled. The ascospores are smooth, spherical to ovoid, hyaline, 2-3μ in diameter (Fig. 33).

Zymonema farciminosum (Rivolta) Dodge, n. comb.

Cryptococcus farciminosus Rivolta, Dei parassiti vegetali. . . . 246-252, 524-525, 1873 (fide Ciferri & Redaelli, Boll. Ist. Sieroterap. Milanese **13**: [8], 1934); Rivolta & Micellone, Giorn. Anat. Fisiol. Patol. Anim. **15**: 143-162, 1883.

Saccharomyces farciminosus Vuillemin, Rev. Gén. Sci. Pures Appliquées **12**: 740, 1901.

Endomyces ? farciminosus Nègre & Boquet, Bull. Soc. Path. Exot. **10**: 274-276, 1917.

Parendomyces farciminosus Froilano de Mello et al., Arq. Hig. Pat. Exot. **6**: 29, 1918.

Grubyella farciminosa Ota & Langeron, Ann. Parasitol. Hum. Comp. **3**: 71-78, 1925.

Coccidioides farciminosus Vuillemin, Champ. Paras. Homme Anim. 140-141, 1931.

Torulopsis farciminosus Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Histoplasma farciminosum Redaelli & Ciferri, Boll. Sez. Ital. Soc. Internaz. Microbiol. **6**: 376-379, 1934; Ciferri & Redaelli, Boll. Ist. Sieroterap. Milanese **13**: [1-8], 1934.

Saccharomyces equi Marcone, Atti R. Ist. Incoraggiamento Napoli V, **8**: **6**: 1-19, *1 pl.*, 1895.

Cryptococcus Rivoltae Fermi & Aruch, Centralbl. Bakt. I, **17**: 593-600, *4 figs.*, 1895.

Saccharomyces sp. Tokishige, Centralbl. Bakt. I, **19**: 105-113, 1896.

Lymphosporidium equi Gasperini, Accad. Med. Fis. Fiorentina Feb. 27, 1905.

Leucocytozoon piroplasmoides Ducloux, C. R. Soc. Biol. **64**: 593-595, 1908.

Leishmania farciminosa Galli-Valerio, Centralbl. Bakt. I, Ref. **44**: 577-582, *1 fig.*, 1909.

Monilia capsulata Lendner & Knuth, Zeitschr. Infektionskrankh. Hausthiere **17**: 290-308, *Pls. 11-14, 2 figs.*, 1916.

Parendomyces Tokishigei Froilano de Mello & Fernandes, Arq. Hig. Pat. Exot. **6**: 295-296, 298-299, 1918.

Producing epizootic lymphangitis of horse, mule, and rarely of ass, in Southern and Western Europe (and since the war, occasional in Central

Europe), North Africa, and Japan. The lesions are found in regions rich in lymphatics, especially where the skin is liable to be broken by rubbing of the harness, etc. When a wound is infected it fails to heal, appearing brick red and ulcerous, producing a serous, yellowish, sanguinolent liquid which forms thin crusts. The ulcer spreads, the margins thicken, become edematous and painful, often with pruritus. After a week to two months it spreads along the lymphatics, producing hard nodules which gradually soften. The skin over them becomes thin and bursts spontaneously, or by trauma, allowing the escape of a purulent yellowish liquid, mixed with tufts of fibrin. These lesions then resemble the initial lesion. Usually these nodes are found along a single lymphatic vessel. When the nodes are close together, they may become confluent. The lymphatic vessels are hard, knotted, warm, and painful. Frequently, starting on the lower limbs, they reach the shoulder or hips and produce enormous swellings of the prepectoral, prescapular, or inguinal ganglia. From these points other lymphatic vessels are affected and repeat the process or they may be resorbed or form hard tubes without breaking through to the surface. Tumors may form in the ganglia. These swell to the size of a hen's egg or even of a fist, their surface becomes irregular and is surrounded by a zone of infiltration. The tissue of the tumor is transformed into multiple hollow abcesses which may become confluent or reach the surface of the host separately. They may harden and encyst or be very slowly resorbed. The lymphatic vessels may be gorged with liquid accompanied by great edema.

Sometimes only the skin is attacked without involvement of the lymphatics. In this case the lesions resemble those of the nodes but are more superficial. The more superficial ones open after a few days and heal, the deeper ones become abcesses and ulcers which suppurate for several weeks. Very rarely some of the ulcerations bud and promptly form tumors suggestive of papillomata. Occasionally deeper tissues may be involved: periosteum and cartilage (Tokishige), bone (Monod and Vélu), synovia and tendons (Pricolo), testicles (Teppaz, Bridré, Nègre, and Troutte), and veins, colon, lungs (Vélu). They have been reported most frequently on mucous membranes (eye, lips, penis, and vulva).

The lesions are easily reproduced in the horse and the organism has been reported inoculable into testicle of rabbit and into man.

Although discovered by Rivolta and Micellone in 1883, this organism was not cultivated with comparative ease until recently. In 1895 Marcone secured growth on horse serum to which he added glucose, glycerol, and cane sugar. He observed large spherical cells which either sprouted or elongated. Observing bodies within the elongate cells, he concluded they were internal spores. He was able to reproduce the disease with his cultures. The same year Fermi & Aruch isolated a yeast, probably a contaminant, which grew luxuriantly on potato. In 1896 Tokishige studied an epizootic on horses and ruminants which clinically appeared to be the same as the European disease. He isolated an organism which greatly resembled that of Marcone but was unable to reproduce the disease with it, except in a single case, although he succeeded easily when pus was used. In 1898 Baruchello apparently also cultivated the same organism as Marcone and Tokishige. In 1906, San Felice succeeded in growing microcolonies, but was unable to keep them alive very long, although he was able to reproduce the disease. In spite of these seeming successes, the next few years saw several hypotheses that the organism was a protozoon, the authors explaining the presence of hyphae in the cultures of earlier workers as contaminations in spite of the observations of San Felice who controlled his studies by microscopic examination. In 1916, Lindner and Knuth renamed the organism *Monilia capsulata*. During the decade of the World War, Boquet and Nègre and their coworkers made a very thorough study of the problem and developed methods for its cultivation. The last decade has seen their work confirmed by several German workers.

In the tissues, cells are spherical or ovoid, or acuminate at the two poles, sprouting, 3-5 × 2.5-3.5μ in diameter, membrane of variable thickness, granular. Occasionally elongate cells seen or larger cells, 5-7μ in diameter.

In cultures, hyphae 2μ in diameter, septa about 10-20μ apart, finely granular, no oil globules, branched. Yeast cells pyriform, thin-walled, at first, becoming thick-walled after the cell separates from the parent cell, containing oil globules which may be large as the cell increases in size up to 8-12μ or even 15-16μ. Thick-walled hyphae formed from these yeast cells, 3-4μ in diameter, with septa 10-18μ apart and oil globules present. Chlamydospores from thick-walled mycelium, usually terminal, slightly polyhedral, 10-18μ, protoplasm granular without oil globules. In old cultures the mycelium breaks up into somewhat irregular, thick-walled arthrospores. Asci 4-spored. [The ascospores figured by Tokishige were undoubtedly drops of oil.] Everbeck (1926) reports ascospores, thick-walled, ovoid, 3 × 2μ, regularly produced after 14 weeks.

In tissues from animal inoculations, yeast cells 3-4μ, or, when actively sprouting, 5-6μ, in groups of 10-15, and some thick-walled hyphae. The antibodies appear about the twentieth day of the disease and remain a long time after cure, so that it is very difficult to inoculate a horse which has had the disease.

For isolation and early subcultures Boquet & Nègre report best results with the following medium:

Macerate 400 gm. horse dung in 2,000 c.c. of water for 24 hours in a cool place; strain through cheesecloth, squeeze, filter, and add 10 gm. peptone and 18 gm. agar for each 1,000 c.c. of filtrate. Sterilize for 30 minutes at 120° C., add 40 gm. glucose per 1,000 c.c., tube and sterilize for 20 minutes at 115° C. For isolation add 20 drops of the following solution to the tubes after inoculation: chop 100 gm. lymphatic ganglions of the horse, macerate for 24 hours in 500 c.c. water, strain through cheesecloth, squeeze, filter, add 20 gm. glucose, tube and sterilize for 30 minutes at 115° C. Moisten cultures with this liquid as they begin to dry out. Incubate at 25-30° C.

On dung agar, after 4-6 weeks, colonies appear on surface, as small, round, elevated, grayish white, slightly velvety, the size of a pinhead. The colonies grow in height and at the periphery and turn brown, becoming contorted and scattered with small white, velvety points, with a white velvety area at the periphery which is festooned. Colonies hard, compact, adherent to the agar.

On Sabouraud agar moistened with maceration of ganglia, the young colonies appear as on dung agar, the older colonies more folded and yellowish white, sandy, somewhat darker in age. Time of incubation shorter on successive subcultures (first in 1 month, fifth in 3 weeks, tenth in 10 days). Between the fifth and tenth subcultures, organism is inoculable into ordinary agar, glucose agar, malt agar, with same aspect as on Sabouraud agar, but less abundant and less velvety growth. On carrot and potato, colony elevated, slightly folded, brownish gray, darkening in age, moist, smooth. On gelatin, white velvety colonies, medium rapidly liquefied. On milk growth very slow, milk coagulated.

Mycelium produced in the water of condensation of horse or sheep serum with 6% glycerol, horse serum agar, ordinary peptone agar, or glucose bean (2% agar with 20 drops of bean decoction added). The mycelium is oidiform, irregular with chlamydospores.

While liquid media are not suitable for isolation or early subcultures, growth is possible after a time on peptone (1%) and glucose (5%), if the inoculum is floated on the surface and the culture incubated at 35° C. There is formed a thick whitish pellicle composed of yeast cells, spherical or ovoid, overlying the limpid liquid. Finally mycelium appears in the pellicle. If 0.5% agar is added to increase the viscosity, the pellicle is thick, folded, snow white, composed of yeast cells and, especially, thick-walled hyphae similar to those on Sabouraud agar.

The optimum temperature is 37° C., but the medium dries out too rapidly; growth at this temperature is about twice as fast as at 25-30° C. At the higher temperature, the colonies are softer, more spongy, with more velvet, and not so adherent to the substrate. The maximum temperature is 38-40° and the minimum 15-18° C. At lower temperatures growth is very slow in the early subcultures, becoming more rapid after the organism has become adjusted to artificial media. At room temperatures, the colonies are elevated, folded, white, powdery or velvety, composed of very thin-walled hyphae and some sprout cells. After some weeks, short thick-walled hyphae are seen and the septa are more evident. In liquid media development is very slow at 20-25° C. If a culture is removed from 35-36° to 20-25°, it produces a grayish folded pellicle, the yeast cells cease budding and produce slender thin-walled hyphae as on glucose. If the culture is removed from 20-25° to 30-36°, the number of yeast cells increases. In low oxygen tension (under a layer of oil) growth is very slow, large irregular cells 12-15μ in diameter, thick-walled, granular, often in chains of 5-6 cells with large oil globules. Citric acid up to 1:2,000 favors growth, producing a grayish folded pellicle or small round white colonies floating on or in the medium. Mycelial forms at low temperatures similar to those seen in pus. Bierbaum (1919) found slow growth on slightly alkaline horse meat agar with 2% glucose, 2.5% glycerol, and 3-4 c.c.

sterile horse serum. Lange (1921) used egg medium with 2% glucose and 1% glycerol, reporting colonies small, brownish yellow, dry, center elevated, margin flattened, edge like a rampart, confluent near water of condensation.

No fermentation of sugars, only glucose and sucrose utilized. Ammonia produced from peptone. Milk coagulated, gelatin rapidly liquefied.

Zymonema Molardi (Salvat & Fontoynont) Dodge, n. comb.

Endomyces Molardi Salvat & Fontoynont, Bull. Soc. Path. Exot. **15**: 311-320, 1922.

Endomyces Molardi Fontoynont (nomen nudum) Bull. Mém. Soc. Chirurg. Paris **48**: 439-442, 1922.

Isolated from lesion on leg of man inoculated by scratching, (?) at first a fistula, then an ulcer, with depigmentation. Lesion finally cured by external applications of methylene blue for about one month. Inoculation on thigh of a guinea pig caused abscess which healed spontaneously. Intraperitoneal injection caused a nephritis which was fatal in 34-44 days. Organism recovered from the blood.

Hyphae occasionally 2-3 fields long, 2.5-3.5μ in diameter, irregularly septate or fragmented, appearing nearly empty, tinted slightly pale rose by Gram's method. Yeast forms visible. Hyphae 2-6μ in diameter, contracted as septa, thick-walled, very rich in glycogen. Filament may terminate in a simple cell, a group of short, thick-walled, nearly round cells, one to two times as thick as the penultimate cell; or it may end by a spherical cell, 8-22μ in diameter, thick-walled, staining with aqueous eosin (chlamydospore). These chlamydospores appear occasionally in groups or short chains. Ascospores appear on glycerol agar or in liquid of glycerol-carrot. Asci spherical or ellipsoid, 4-spored, rarely 8-spored.

On glycerol agar, growth rapid, colony thick, creamy, ivory white, elevated with little deeper yellow craters in the middle and never reaching the side of the tube. On Sabouraud maltose, growth as on glycerol but colony dirty, yellowish white. On Sabouraud glucose, growth less abundant, with slightly elevated polycyclic plateau, center creamy, white, glistening, then opaque. On fifteenth day fine radiations from central cone. On carrot with glycerol, from streak, growth appears like white porcelain, is thick, glistening, creamy, composed of a mass of granular colonies. Hyphae on walls of tube in fifth month, the whole surface is invaded and becomes crateriform, moist below, dryer above. Growth on potato and turnip with glycerol same as for carrot. Growth from gelatin stab appears like inverted fir tree. On surface plateau 8 mm. in diameter, three zones: (1) outer, 1 mm. broad, fine radiating lines, (2) higher, 3 mm. wide, abrupt drop to outer zone, (3) uppermost, 3 mm. broad, granular. On horse serum, growth is meager, old ivory in color. On solid media, only yeastlike cells appear. In liquids a slight pellicle and very fragile ring appears, sediment is flocculent and abundant, liquid remains clear. On lactose bouillon, growth is good; even after 5 months lactose is not exhausted. Medium gradually becomes acid. Growth in glycerol bouillon poor. In Raulin's liquid, growth is fair, white sediment, liquid clear. In Gedoelst liquid, growth very good. Coagulated serum not liquefied. Gelatin not liquefied in 30 days.

Zymonema crateriforme (Hudelo, Sartory & Montlaur) Dodge, n. comb.

Endomyces crateriforme Hudelo, Sartory & Montlaur, C. R. Acad. Sci. **170**: 1086-1088, 1920.

Saccharomyces, sp. Hudelo, Sartory & Montlaur, Bull. Sci. Pharmacol. **25**: 352-357, 1918.

Isolated from a lesion in the armpit of a young woman. Lesion oval, 3 cm. in diameter, erythematous, scaly, reminding one of dry seborrheic eczema. Nonpathogenic to rabbits and guinea pigs, by either subcutaneous, intraperitoneal, or intravenous injections. On scarification an atypical, evanescent lesion results.

Submerged mycelium shows yeastlike budding cells, 9-11μ, or oidial cells, 15-16μ long. Conidia sprouting from aerial mycelial branches on some sort of sterigmata are variable but usually ellipsoid or ovoid, 5-7 × 6-9μ. Asci appear on solid media and old cultures after 80 hours at 22-23° C. These are usually terminal, rarely intercalary, 4-5μ in diameter, containing 4 spores each. Spores 3-3.5 × 1.75-2μ, with single smooth membrane.

On Sabouraud agar, colony is small and white, becoming creamy white, center yellow and irregularly crateriform, finally crackled, appearing like small sponge. On carrot or potato, colony broader, thicker with several small craters, very much folded, cream white, covered with conidia. On broth gelatin, colony not fully developed before liquefaction on seventh day. After 18 days on malt extract, colony appears as thick, dry, folded mat covered with conidia, sediment of yeast cells, feeble fermentation with slightly aromatic odor. Growth similar on beef broth, peptone + glycerol + glucose broth, normal Raulin's solution with glucose, lactose, galactose or maltose, or on prune decoction. Sucrose, glucose, fructose fermented, not raffinose, lactose, galactose, or maltose. Starch paste not liquefied. Milk not coagulated in 34 days. Gelatin liquefied.

Zymonema albicans (Okabe) Dodge, n. comb.

Endomyces albicans Okabe, Centralbl. Bakt. I, **111**: 181-187, *1 pl.*, 1929, non aliorum.

Isolated from 49 cases of thrush, in Japan, and pathogenicity of this strain proved. [*"Monilia candida,"* a filamentous species with strong fermentation of sucrose and a strain which completely failed to ferment, also isolated from some of the above cases, but proved to be nonpathogenic.]

Yeast cells spherical or ovoid, 4-6μ in diameter, with giant cells in old cultures reaching 15-20μ, after a time elongating and forming mycelium. Mycelium 3-4μ in diameter, cells 20-30μ long, rarely up to 80μ. Chlamydospores pyriform, spherical or ovoid, 7-12μ in diameter. Asci in 45 strains 1-spored, rarely 2-4-spored, 5-6μ in diameter; ascospores spherical to ellipsoid, 3.5-4 × 2.5-3μ, thick-walled, asci found only in the yeast stage, not on the mycelium, produced only on koji extract agar after 4-6 months.

On koji extract agar, colony thin, milky white, smooth, surface moist with sharp borders, becoming thicker, duller, yellowish white; on drying, becoming brownish yellow with an ashy gray powder, mycelium very scarce. On 10% sucrose peptone agar, mycelium produced, colony verrucose and folded. No pellicle on liquid media, powdery sediment. On sucrose peptone solution, mycelium floating as woolly masses hanging from the ring. By Lendner method, fermentation with glucose, levulose, mannose, maltose shows strong acid and gas; dextrin and galactose show slight acid and gas, soon disappearing; no action on other sugars tried. Growth better at 37° C., than at 25° C.; growth possible in ice box or at 40°.

Zymonema bonaerense (Greco) Dodge, n. comb.

Endomyces bonaerensis Greco, Argentina médica 1908; Origine des Tumeurs. 123-156, 412-421, *Figs. 54-68, 225-231*, 1916.

Producing small miliary abscesses and plaques near eye. Pathogenic for rabbit, forming subcutaneous abscesses.

Yeast cells 4-6 × 2-4μ, ovoid, hyphae mostly 2-4μ in diameter, occasionally much thicker and shorter. Asci 4-12μ spherical, spores 1-2μ.

Colonies milk-white, shining, discrete, or becoming confluent. On solid media after about a month, hyphae begin to show in the media. No gas but an ethereal odor in some cultures. On Sabouraud agar, growth at 20° and 37° white, creamy, a little thicker in the center, with filaments at the periphery. On beef agar and glycerol agar, growth less, colony flatter, more opaque, less shining white. On potato, colony creamy, very moist, white, later more opaque and grayish. On drying, small secondary yeast colonies form on surface of mother colony. Potato glycerol shows better growth, dryer, mammillate or slightly crateriform, slightly yellowish and cheesy in appearance, medium darkened. On carrot, colony creamy, spreading, white margin toothed. On liquid media no discoloration of media, no pellicle, but sediment produced. Sugars not fermented. Milk coagulated very slowly. Colony on gelatin stab resembles a test tube brush, without radial filaments, no liquefaction.

The figures and description are not altogether convincing as to presence of ascospores, and I have hesitated to transfer it to this genus, but it is quite evidently not *Endomyces*.

Zymonema album, Dodge, n. sp.

Monilia sp. Bianchi & Niño, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **4**: 531-538, *6 figs.*, 1927.

Producing bronchomycosis. Pathogenic for guinea pig.

Spherical yeast cells about 3μ in diameter; ovoid cells 3-5 × 2μ. Cells 10-12μ in diameter, thick-walled with four deeply staining bodies which may be ascospores. In old cultures on glycerol, carrot, and potato, there are slender mycelium and large chlamydospores. This mycelial form continues on subculture.

Colonies hemispheric, creamy white, moist, finally becoming confluent with a dryer, whiter margin. Optimum temperature 37°, but fair growth at 20° C.

On potato glycerol, medium darkened; serum not liquefied, milk coagulated in 24 hours. In Raulin's solution, sediment, but not turbidity. Drigalski-Conradi slightly acid in 4 days. On neutral red agar, gas in 24 hours, color change in 4 days. No indol. No fermentation of sugars. Acid produced from glucose, fructose, galactose, lactose, and arabinose, no action on mannite, sucrose, raffinose, and inulin.

Zymonema bucalis (Niño & Puglisi) Dodge, n. comb.

Monilia bucalis Niño & Puglisi, Semana Méd. **34**: 222-229, 1927.

The lesions began as perlèche, extending gradually over the buccal mucosa which became covered by white plaques, slightly adherent, not continuous, suggesting clots of curdled milk, extending into the tonsillar crypts, producing a burning sensation.

Yeast cells and hyphae 2.5-3μ, little branched. In cultures yeast cells 3-7 × 2-5μ; asci spherical, 10μ in diameter, with 2-4 ascospores. Hyphae developing from thick-walled cells, flexuous, little branched, 1.5-3μ in diameter; blastospores lateral; large terminal chlamydospores present.

Colonies at 37° C. on Sabouraud agar, potato-8% glycerol, carrot, and potato agar, circular, confluent, moist, white, little elevated. On liquid media (broth, potato decoction, 2% peptone solution and maltose-peptone solution) turbidity, with the formation of white clots, which settle to the bottom. Drigalski-Conradi medium becomes red, then decolorized; litmus sugar agars become red, then decolorized, and finally become blue. Acid on glucose, sucrose, and lactose, not on mannite. Sucrose not inverted, starch digested. Sugars not fermented. Milk coagulated on the third day, no liquefaction of gelatin nor of coagulated serum.

Zymonema Cruzi (Froilano de Mello & Paes) Dodge, n. comb.

Endomyces Cruzi Froilano de Mello & Paes, Arq. Hig. Pat. Exot. **6**: 51-60, 1918.

Isolated from sputum of patient suffering from bronchitis and asthma.

In sputum cells 4-8 × 2-4μ, rarely spherical, with refringent granules. No hyphae or spores present. On potato, cells ovoid or spherical, pseudomycelia 50-80μ long, simple or branched. Spherical or reniform asci present, 2-4-spored. On simple agar, spherical cells in chains of 8 to 16, no asci.

On 1% agar + 6 drops of 10% NaOH, mycelial filaments definitely septate, 100μ long with terminal chlamydospores or lateral conidia at the septa, and arthrospore formation. On 10 gm. agar + 5 drops 10% NaOH, some yeast cells, mycelium, terminal chlamydospores. On 10 gm. agar + 4 drops 10% NaOH, feeble development, yeast cells, no true mycelium, asci abundant.

On simple agar, feeble development, small milk-white colonies. On maltose agar (Sabouraud), colony white, then yellowish, verrucose. Colonies on potato, circular, elevated, wax color, opaque. Broth becomes cloudy after 72 hours with flocci in suspension, forming a filiform sediment. On Raulin liquid, thin whitish pellicle becoming thicker and chalky spotted, with small white points above and below with streamers 1-2 cm. long protruding into the liquid, finally breaking off and forming filiform sediment at bottom of the tube. Glucose, maltose, and sucrose fermented.

Zymonema Alvarezsotoi (Mazza & Niño) Dodge, n. comb.

Monilia Alvarezsotoi Mazza & Niño, apud Mazza, Niño, Quintana & Bernasconi, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **6**: 180-214, *38 figs.,* 1931.

Generalized mycosis of native of Argentina. Fungus isolated from caseous lumps in feces, from lumps in the sputum and from the urine. Patient finally succumbed. Pathogenic to white rat, guinea pig, in intraperitoneal injection, to rabbit intravenously or applied to the mucous membranes. In one rabbit subcutaneous injection resulted in subcutaneous nodules which were surgically removed. The animal recovered completely.

On Sabouraud solid media, yeast cells mostly round, variable in size, some sprouting. No hyphae or asci observed. On coagulated human serum, after one month, many yeast cells, mostly round, 1-10μ in diameter. Rare ovoid forms. Few hyphae, composed of chains of fusiform, granular cells of variable size. Lateral branches at septa. Occasionally two large cells, approximately of equal size, and with thick membrane, are joined by a narrow neck [isogamous copulation?]. Morphology in Gougerot gelatin slightly different. Hyphae predominate. These are variable in size, flexuous, composed of chains with lateral ramifications. Some spherical or ovoid cells are united directly to the hyphae or by little pedicels [immature asci?]. There are intercalary or terminal swellings resembling chlamydospores. Some cells are cylindric with rounded ends, $10 \times 2\mu$, vacuolate. In some filaments, internal spores like oidia. Optimum temperature for growth 30-37° C., no growth at 50° C. Gram-positive or negative. With Leishman stain, protoplasm sky blue, chromatin granules garnet.

On Sabouraud glucose agar, colony rugose yellowish. Same on Sabouraud maltose. Good growth on agar and carrot. On potato, growth also good with darkening of medium. No growth on Drigalski medium. On potato, with 8% glycerol, good growth in 24 hours with darkening of medium. Colony white, humid, covering the whole surface. Pellicle on top of liquid and deposit at bottom of tube. On carrot, with 8% glycerol, abundant growth in 24 hours, colonies white, humid, covering whole surface of medium. Some days later on upper part of edge some white, agglutinated hyphae appear. Pellicle on surface of liquid ascending walls of tube. On Gougerot gelatin stab, rugose, caramel-colored pellicle on surface of medium, presently darkening on top. On plain gelatin stab at 15° C., dendroid growth along whole length of stab. On gelatin streak, good growth, best at the bottom where some lateral arborescences appear. Along coagulated human serum stab, growth slow and dendroid. In plain broth and Sabouraud broth, turbidity and sediment in clots. In acid Raulin's solution, sediment in clots without turbidity. Starch paste unaltered. No fermentation of sucrose, raffinose, lactose, maltose, mannite, sorbite, dextrin, or inulin. Slight acidity but no fermentation with glucose, fructose, and galactose. No indol formation. Milk not coagulated. Coagulated human serum slowly liquefied. No effect on gelatin in 30 days.

While no asci or ascospores have been reported in the following species, its pathogenicity, its cultural characters, and morphology all place it in *Zymonema* rather than *Mycoderma*, very close to *Z. dermatitidis*.

Zymonema Harteri (Verdun) Dodge, n. comb.

Cryptococcus Harteri Verdun, Précis Parasitol., 1912.

Atelosaccharomyces Harteri Beurmann & Gougerot, 1913.

Parasaccharomyces Harteri Froilano de Mello, Paes & Sousa, Arq. Hig. Pat. Exot. **6**: 33, 1918.

Myceloblastanon Harteri Ota, Jap. Jour. Derm. Urol. **28**: [4] 1928.

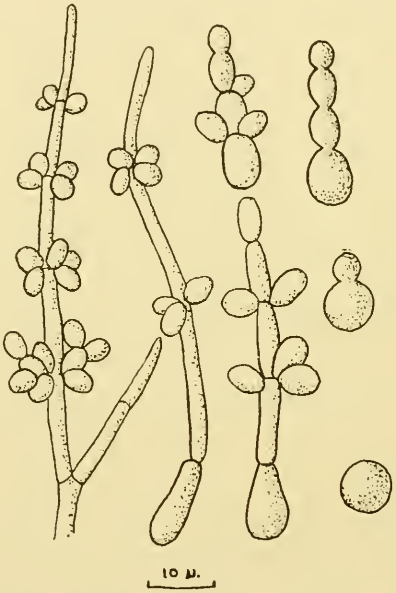

Fig. 35.—*Zymonema Harteri.* (After Pollacci & Nannizzi 1926.)

Monilia Harteri Vuillemin, *Champ. Paras. Homme. Anim.* 85, 1931.

Mycotorula albicans Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 47, 1932, *pro parte*.

Torulopsis Harteri Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from a case of generalized blastomycosis presumably contracted in Cochin China. The organism has evidently invaded the intestinal tract, liver, lungs and finally produced subcutaneous nodules. [Case of Harter, C. R. Soc. Biol. **64**: 241-242, 1908; De la blastomycose humaine, Thèse Fac. Méd. Univ. Nancy **20**: 1-222, 1909.] Pathogenic for rabbits and mice. Medication with KI ineffective.

Sprout cells ovoid or ellipsoid, 4-6 × 3-5μ, somewhat larger in liquid media, with some spherical cells in old cultures. On solid media elongate cells

8-15 × 5-6μ appear. Hyphae about 2μ in diameter with occasional swellings up to 3μ seen in Raulin's liquid. Chlamydospores 5-8μ with very thick walls seen on carrot. Asci not observed (Fig. 35).

Growth over a wide temperature range between 10 and 55° C., with good growth at 37° C., and at room temperature. On glycerol agar, growth abundant, white, smooth, velvety in the depths; cells ovoid, with very large vacuoles in old cultures. On sucrose or glucose agar, growth creamy, abundant, shining with only ovoid cells. On ordinary agar, growth poor, granular with little penetration of the substrate. On carrot and turnip, growth creamy, white, smooth or granular, becoming mamillate, or even crateriform in old cultures, developing hyphae; cells at first ovoid, soon becoming elongate and mycelial. On potato, growth slow, grayish, soon dry. On gelatin, colonies white, granular, with dendroid growth in the medium; cells elongate or ellipsoid in the depths but no hyphae, ovoid at the surface. On blood serum, colony grayish white. In liquid media, floccose growth which slowly settles without producing ring or pellicle. Milk not coagulated, gelatin not liquefied after 8 months. No fermentation, sucrose only slightly inverted.

I have been unable to locate the original descriptions of the following species and know them only from secondary sources.

Endomyces pulmonalis Senez, Boletín del Lab. de Bact. Tucumán (Argentina) **1**: 58-60, 1918. [Reviewed in Bull. Inst. Pasteur **17**: 636, 1919; Perin, Micosi polmonari 94-95, 1925; Pollacci & Nannizzi, I, *Miceti Patogeni* **4**: No. 34, 1925.]

Isolated from sputum of patient suspected to have tuberculosis.

Creamy white colonies, asci ovoid, 4-spored, 10μ in diameter.

Zymonema histosporocellularis Haberfeld, Tesis, 108 pp., *21 figs.*, São Paulo, 1919.

Mycoderma histosporocellularis Neveu-Lemaire, Précis Parasitol. Hum. 70, 1921.

This species is said to be a synonym of *Paracoccidioides brasiliensis* (Almeida 1933).

OLEINA

Oleina Tieghem, Jour. de Bot. [Morot] **1**: 289-292, 1887.

Raquet mycelium well developed, intercalary chlamydospores present; asci spherical, either intercalary or lateral, no trace of sexuality observed; ascospores, 8 per ascus, varying from ellipsoid to spherical.

No type species was designated. *O. nodosa* (Fig. 35, *3*) was found growing on fresh cartilage which was floating in olive oil during some studies of saprophytic fungi growing in oil. In this species the asci are intercalary, the spores ellipsoid, 4 × 6μ. *O. lateralis* (Fig. 35, *4*), in which the asci are lateral and the ascospores spherical, 5μ in diameter, was found on a bit of water-soaked cotton floated on the olive oil in similar experiments. It was cultivated also on cartilage and maintained its distinctive characters. Yeast cell stage unknown, probably not normally present, as the author states that the chlamydospores germinate directly by germ tubes.

The normal habitat of this genus is rather problematical. The cultures were made before the technic of pure culture had been highly developed, so that probably the cartilage had not been sterilized and the organism may have been present in it, or it may have been present in the surrounding oil. It is to be hoped that these organisms may be again encountered and studied. There is no trace of sexuality observed, so that this may represent an end member of a series. The relationship of *Octomyces* Froilano de Mello & Gonzaga Fernandes is also problematical.

OCTOMYCES

Octomyces Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 237-242, 1918.

Mycelium septate, sprout mycelium also present; asci 1-, 2-, 4-, and 8-spored; chlamydospores terminal.

Type species *Octomyces Bettencourti* Froilano de Mello & Gonzaga Fernandes.

The type was originally isolated from a contamination at Nova Goa, so that nothing is known of its normal habitat. This genus may be considered as a synonym of *Oleina,* but it differs in the absence of raquet mycelium, the presence of sprout mycelium, and in the terminal rather than intercalary chlamydospores, which seem to be produced only in liquid media. Both genera have been rather poorly described and need much further study before their systematic position will be known. Neither seems to have a well-developed sexuality, such as found in *Eremascus* and *Zymonema.*

Octomyces Bettencourti Froilano de Mello & Gonzaga Fernandes, *Arq. Hig. Pat. Exot.* **6**: 237-242, 1918.

Isolated from contamination in a Petri dish, at Nova Goa.

Mycelium septate, yeast cells spherical with brown granules, asci ellipsoid, spherical, and lanceolate, 1-, 2-, 4-, and 8-spored. Chlamydospores terminal, yeast cells not sprouting.

On glucose and maltose agar, colony moist, dirty white streak, same morphology as on potato. On potato, colony dry, very wavy, margins indented. On carrot, culture dry, very wavy, dirty white, granular in appearance.

In broth, easily dissociable pellicle and sediment, no turbidity, with no fermentation, acid with dextrin, fructose, maltose, no action with lactose, mannite, or glucose.

Octomyces Etiennei (Potron) Dodge, n. comb.

Saccharomyces Etiennei Potron, Rev. Méd. de l'Est. **45**: 814-826, 841-855, *3 figs.*, 1913.

Isolated from severe pleuropulmonary infection and bronchopneumonia with abundant yeasts appearing in the sputum. Producing local pyogenesis in rabbit and guinea pig.

Cells spherical, rarely ellipsoid, mostly 3-9 × 1.5-4.5μ. When actively budding, cells are 15-18 × 4-5μ, with the formation of pseudomycelium but no true mycelium on turnip, liver decoction, and glycosuric urine. In other media, especially carrot and potato, cells separate early. On turnip, filamentous forms found, spherical cells about 6μ in diameter, asci abundant. Irregular allantoid forms found, also durable cells. Elongate forms on glycerol artichoke as well as on turnip. Budding forms abundant in liquid media, especially in the pellicle of old cultures. No trace of copulation before the formation of the ascospores, which are 4 per ascus and measure 2-2.5μ. Asci 7-8 × 5μ. The ascospores swell and begin budding, still without any trace of copulation. No especial cultural conditions seem necessary for ascospore formation.

On Sabouraud agar, colonies white, punctiform, rapidly confluent, forming a white, creamy, shining, flat surface elevated more than 1 mm.; margins crenulate. Colonies on potato grayish white, punctiform, spherical, very much elevated above the surface. As each colony grows rapidly, it becomes acuminate in appearance and is confluent with neighboring colonies. When the medium dries, the colonies become chalky white. On carrot, development is more rapid than on potato. Colonies white, rapidly confluent into a varnished, creamy surface. On turnip, growth at first similar to that on potato, then colony becomes prominent, surface mammillate, pebbled, remaining grayish white as the medium dries out. On artichoke, growth is slow but otherwise resembles that on carrot. Glycerol, on vegetable media, somewhat inhibits growth. On gelatin, combined with Lasseur's medium, colonies grayish white, develop slowly and are very slowly confluent, if at all. On liver decoction gelatin, grayish white, elevated, punctiform colonies. Development is rapid and abundant. On gelatin, combined with normal Raulin solution, colonies grayish white, rapidly confluent to give the appearance of shagreen. In pepto-glycerol broth, development is slow, slight turbidity at first, with deposit of flocci at the bottom. Lasseur's medium is not especially favorable, development is as in pepto-glycerol broth. On Courmont's medium with glucose, development is rapid, sediment abundant, pellicle thick; with galactose and lactose, sediment even more abundant; with sucrose, sediment less marked, pellicle feeble; with maltose, sediment very marked, pellicle conspicuous; with inulin growth, slow at first, with pellicle and sediment finally appearing; with starch deposit, development slow. Grown in Sartory's mutton liver decoction, organism causes grayish floccose sediment, leaving liquid clear. In glycosuric urine, containing 10 gm. glucose per liter, abundant deposit appeared, liquid clear with some gas evolution, then appearance of pellicle. Ring also after glucose had fermented. In normal Raulin's solution, a powdery white deposit appeared on the walls and bottom of container. Fermentation occurred with glucose, fructose, galactose, lactose, maltose, and sucrose. Slight action on dextrin, none on inulin, starch, or mannite. Milk very slowly coagulated on the tenth day, with the evolution of CO_2 gas. Curd not digested. Gelatin not liquefied.

BARGELLINIA

Bargellinia Borzi, Malpighia **2**: 469-476, 1889.

Hyphae very slender, hyaline, irregularly branched, septa remote; asci solitary, terminal, spherical, membrane thickened, minutely tuberculate scabrous, more or less brownish, indehiscent, spores spherical or subspheric, solitary, rarely 2 per ascus, wall thin, content oleaginous.

This genus seems not to have been seen since its original isolation. It was not figured. Some characters suggest that it may be based on a misinterpretation of *Hemispora*, in which the oil globules have been mistaken for ascospores. Until it is found again and more carefully studied, it should be regarded as doubtful.

Bargellinia monospora Borzi, Malpighia **2**: 476, 1889.

Isolated from the external auditory conduit in catarrhal otitis.

Hyphae subequal, 2-4μ in diameter, with distant septa; asci more or less distant and indehiscent, 8-12μ. Spores spherical or nearly so, solitary or 2 per ascus, smooth, guttulate, 5-7μ in diameter.

HEMISPORA

Hemispora Vuillemin, Bull. Soc. Myc. France **22**: 125-130, *Pl. 7,* 1906.

Trachytora Saccardo, Syll. Fung. **4**: 262-263, 1886 [as subgenus only].

Sporendonema Ciferri & Redaelli, Jour. Trop. Med. Hyg. **37**: 167-170, 1934; Redaelli & Ciferri, Atti Ist Bot. R. Univ. Pavia IV, **5**: 145-198, 1934 not Desmazières 1827 nor Oudemans 1885.

The type species is *Hemispora stellata* Vuillemin.

In tissues, yeastlike cells; in cultures, hyphae hyaline, septate, producing chlamydospores and conidia (blastospores?); asci in chains without trace of sexuality, containing a single echinulate spore.

The morphologic interpretation of structures in this genus has long been puzzling. Vuillemin considered the structures here called asci as hemispores or deuteroconidia, representing an intermediate phylogenetic stage between arthrospores and true conidia (limited by Vuillemin to the types produced by phialides). More careful cytologic studies by Moore (1934) have shown that in *H. coremiformis* the asci are borne in chains at the ends of branches. In the early stage they resemble a chain of arthrospores or conidia on the end of a conidiophore. Then a densely staining structure develops within the cell walls which eventually forms an echinulate spore wall. The ascus wall then degenerates, leaving the ascospore free. The abundant formation of coremia in this species suggests that on equally careful cytologic study, *Briosia,* a saprophytic genus of the Fungi Imperfecti, might belong here.

The species placed in this genus by Castellani belong elsewhere. Ciferri & Redaelli (1934) and Redaelli & Ciferri (1934) have attempted a comparative study of several organisms referred to this species, but since none of their organisms seem to agree with the morphology originally described by Vuillemin, it is doubtful whether they had the same organism as Vuillemin in his original paper. Among others they had a culture which originally came from Vuillemin, but there were no data to show that it was the strain upon which his original description was based. Their only strain which at all resembled *H. stellata* was isolated along with *Aspergillus* and may have also been parasitic on the latter. This strain differed more widely from their other strains than the other strains differed among themselves. If the name *H. stellata* should be found to apply to a parasite of Aspergillus sp., then the determination by be found to apply to a parasite of *Aspergillus* sp., then the determination by cold abscesses, would remain in doubt.

Hemispora stellata Vuillemin, Bull. Soc. Myc. France **22**: 125-130, *Pl. 7,* 1906.

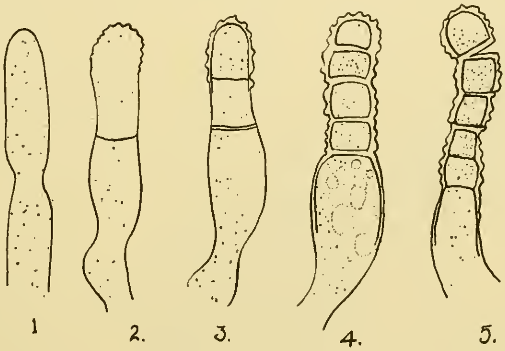

Fig. 36.—*Hemispora stellata.* (After Vuillemin 1906.)

Sporendonema epizoum Ciferri & Redaelli, Jour. Trop. Med. Hyg. **37**: 167-170, 1934; Redaelli & Ciferri, Atti Ist. Bot. R. Univ. Pavia IV, **5**: 145-198, *5 figs.,* 1934, excl. syn., *quoad* "ceppo Pun."

Originally described as a parasite of *Aspergillus repens* forming a hyphal mat on the surface of a jar of preserved pears. Subsequently reported from cases of osteoperiosteitis by Gougerot & Caraven (1909, 1910) and from cold abscesses on penis by Beurmann, Clair & Gougerot (1909). Vuillemin identified the organisms in these cases. More recently Fonseca & Arêa Leão (1927) report it from a sporotrichoid lesion on the arm. Cultures from lesions were pathogenic for rabbits, producing periosteitis. *Torula epizoa* Corda, in Sturm, Deutschl. Fl. III, **3**: 97-98, *Pl. 45,* 1829, upon which Ciferri & Redaelli base their specific name, was isolated from tallow, and judging from Corda's figures is not related to the organism under consideration. I find no mention of the species in Corda's later publications.

Arthrospores in chains up to 30 or more, subspheric, 2.6-3.5μ with a fuliginous granular wall except on the facet of insertion, occasionally elongate and barrel-shaped (Fig. 36). Hyphae 2-3μ in diameter, irregularly septate.

Colonies white, 0.5-2.5 mm. in diameter covered with conidiophores making little brown star-shaped spots. On sugar media, colony blackish brown, at first smooth and mammillate or irregular and coarsely convoluted, becoming powdered with ochraceous spores. Aerobic, not liquefying gelatin.

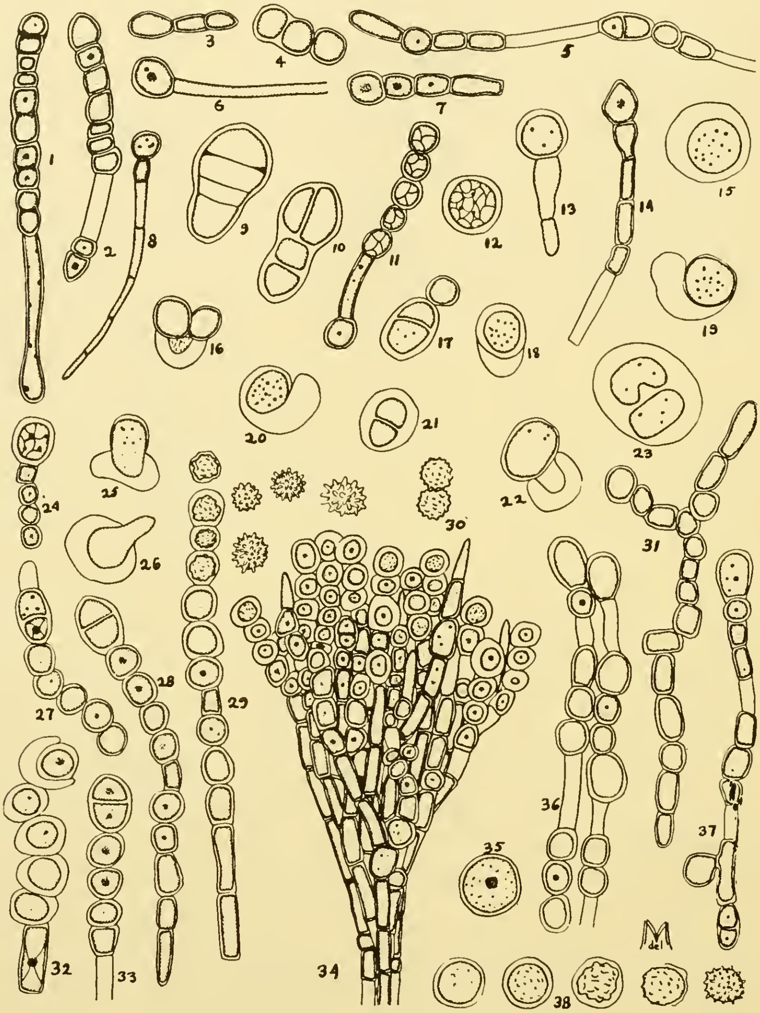

Fig. 37.—*Hemispora coremiformis.* *1*, hypha showing septation in lactose broth; *2, 3, 5, 31, 37*, mycelium showing variation on various media; *4, 17*, hemispores; *6, 7, 12-14, 24, 33, 35*, huge terminal cells (chlamydospores [?]) on various media; *8*, young filament; *9, 10*, ampulliform cells on potato glucose agar; *11*, deuteroconidia; *15, 16, 18-23, 25, 26, 32, 34*, cells on wort agar, showing secretion of a gel; *27, 28*, terminal hemispores; *29*, ascogenous hypha showing single echinulate ascospores. *30*, Adjoining echinulate ascospores formed from hemispore. *34*. coremium. *36*, hyphae from coremium. *38*, Series showing development of echinulate ascospore and disintegration of the ascus. (*1-33, 35-38* ×600; *34* ×500.) (After Moore 1935.)

Hemispora coremiformis Moore, Ann. Missouri Bot. Gard. **21**: 1934 [case of Rotter & Peña Chavarría, Arch. Schiffs Tropenhyg. **38**: 414, 415, *Fig. 10*, 1934].

Isolated from lesions of the skin following scratching a bee sting with soiled hands in Costa Rica. Surface of the lesion is slightly raised and edges irregular, brass red, tissues infiltrated but not painful to touch. Subsequent lesions developed on edge of ear, angle of the jaw and clavicular lesion. The patient was treated with iodine and tartar emetic intravenously and antiseptics locally, with healing in 2 months.

In cultures growth wholly of yeastlike cells and arthrospores for the first half year, then hyphae 2-4μ in diameter developed. Intercalary chlamydospores spherical 6-10μ or ellipsoid 7-9 × 12-15μ; conidia 4-6μ in diameter. Asci spherical to clavate, at first terminal, in chains, apparently without sexuality; ascospores brown, echinulate 3-6μ in diameter (Fig. 37).

On the more acid agars, growth slow, entirely submersed. On wort agar, colony vermiculate, light cinnamon, cells with sheath. On malt extract agar, colony buff to yellowish, vermiculate at center with radial folds and furrows. On Sabouraud agar, colony cerebriform at center surrounded by a ring of coremia, flatter toward the margin, buff to amber. On potato glucose agar, center acuminate surrounded by a cerebriform area from which radiate many furrows, buff. On nutrient agar, colony flat, center slightly elevated, margin irregular giving a stellate appearance. On glycerol agar, colony similar to that on potato glucose but covered with small coremia. On liquid media, no pellicle, flaky sediment. Sugars not fermented, no acid production, milk coagulated, and gelatin liquefied after 12 days.

CHAPTER XI

ENDOMYCETALES—EREMASCACEAE IMPERFECTAE

The species to be discussed may or may not belong in the Endomycetales, since under certain environmental conditions the vegetative stages of many groups may assume a yeastlike appearance. However, when suitable media are employed, it is probable that ascospores will be formed in many species at present considered as imperfect. Judging from previous cases, we may anticipate that the ascosporic stage will place them definitely in the Eremascaceae.

Since cultural studies seem essential in attempting to differentiate the species of a group where the morphology seems variable, the following procedures, advocated by Redaelli and Ciferri (1929), by Talice (1930), and by Langeron & Talice (1932), may be considered as standard until better are produced. They include most of the good features already advocated by Castellani during the previous two decades.

The fungus is easiest isolated on carrot agar,[*] or Sabouraud glucose agar.[†] Spore formation is sought on Gorodkova agar. Cultures are incubated at 20°, 30°, and 37° C. From information gained from these cultures optimum temperature may be determined more accurately if desired.

Comparative cultures may be made on the following media: Raulin, acid, or neutral solution, decoctions of carrot or potato,[‡] malt extract solution (without hops), malt agar (2% agar), 2% glucose agar and corn meal agar (recommended by Smith & Sano, 1933); malt gelatin, carrot gelatin; glucose meat broth with 0.5% methylene blue, skimmed milk and peptone sugar broth (formula of the Committee of the Society of American Bacteriologists).

Descriptions of the colonies on the above-mentioned media should be recorded after 1, 2, 4, 7, 10, and 30 days and even 60 and 90 days are often useful. A microscopic examination should be made on the second, fourth, tenth, thirtieth, sixtieth, and ninetieth days, on the latter days especial search being made for signs of copulation, and ascospore formation. Material should be examined from the bottom growth and pellicle in liquid media, and from the center and edge of the colony on solid media. The material may be mounted in glycerol, lactophenol, or Lugol's solution (water 11 c.c., potassium iodide 2 gm., iodine crystals 1 gm.). They may be stained with Ziehl's carbolfuchsin, Loeffler's alkaline methylene blue, or Ehrlich's anilin methyl [gentian] violet (methods of the Committee of the Soc. Am. Bact.). The cells should never be fixed by heat. A smear may be allowed to evaporate the excess water in air, then it should be fixed rapidly in alcohol and stained. Burri's India ink method and Mitsche & Harrison's collargol methods are useful. Since smears usually separate the cells of the filaments, they should be avoided as far as possible and the morphology compared with that obtained in hanging drops, using either liquid media or media containing 0.1% agar. Langeron & Talice suggest a very thin slant of agar, which is streaked all the way to the glass of the tube. For microscopic observation it is held as desired with two lumps of modeling clay on the stage and observed with an 8 mm. objective and an ocular of high magnification. In giant colonies, one must resort to one of the various devices for growing them, so that they may be uncovered for examination. These often give valuable morphologic details. Microcultures from hanging blocks of agar are useful. On liquid media, a little of the bottom deposit is lifted by a wide-mouthed pipette, and floated on a drop of liquid on the slide. The excess liquid is removed by blotting or by evaporation. It may be stained by the above-mentioned Lugol or by other suitable stains. Hanging drop cultures of dilute potato decoction should also be made. Here, after development has reached a suitable stage, the organism may be allowed to dry to the cover glass and stained if desired. It may be desirable to remove the lanolin which sealed the cover glass to the ring by wiping first with a dry cloth and then with a cloth moistened with toluene.

---

[*] One kilogram of carrots is washed, triturated, and boiled in 1 liter of water for 3 hours. The solution is strained through cheesecloth, cooled, filtered through paper, made up to volume, and 20 gm. agar are added.

[†] Agar 18 gm., White's [Witte?] peptone 30 gm., and glucose 40 gm., water 1 liter.

[‡] Talice recommends the following: Reduce 20 gm. of potato to pulp, suspend in 1,000 c.c. water, boil for 15 minutes, filter through cotton, replace water lost by evaporation, distribute to tubes, and sterilize at 120° for 20 minutes. It should be noted that this solution is about 1/10 the concentration usually employed in Thaxter's potato agar. The more concentrated solution is said not to give such good results.

Pigment formation should be noted. It is quite variable, depending on the composition of the medium, its density, the age of the culture, temperature, light, etc.

Fermentation should next be studied. Unfortunately, Castellani has emphasized this to the exclusion of other characters, while others have failed to confirm his results with many strains, perhaps on account of the method used. Redaelli & Ciferri suggest the following list: arabinose, xylose, rhamnose, glucose, mannose, galactose, fructose, sorbite, dulcite, maltose, lactose, melibiose, sucrose, trehalose, raffinose, starch, soluble dextrin, glycogen, and inulin. However, see remarks on *Monilia* Castellani, pp. 63, 64. The use of Lendner's microfermentation method is inadequate, unless all doubtful cases are studied more quantitatively. Experiments should be controlled carefully and repeated three or four times. The constancy of fermentative power has been questioned (Bahr 1915), probably as a result of too great reliance on Lendner's method (see p. 63). While occasional cultures on a sugar which the fungus does not ferment will not alter its ability, repeated subcultures on that sugar may induce an irregular increase of ability to ferment that sugar which is gradually but irregularly lost when again cultivated on the first medium. Mackie & Chitre (1928), in a study of the intestinal *Moniliae* of India associated with sprue, show that many strains lose their ability to ferment certain sugars in subcultures on laboratory media and may regain this ability on passage through experimental animals. Ability or nonability to ferment maltose was much more constant than that for any other sugars and may be used as a character for the separation of species. The power to ferment other sugars is so variable (in their opinion) that it should not be used to separate species.

A study of utilization of carbon sources is helpful, using Raulin's neutral solution, replacing the sucrose successively by glucose, maltose, lactose, mannose, fructose, inulin, starch and soluble dextrin, methyl alcohol, ethyl alcohol, glycerol, formic acid, acetic acid, oxalic acid, tartaric acid, and citric acid. In the case of the above-mentioned acids, the tartaric acid is replaced by the acid in question rather than the sucrose. Similarly sources of nitrogen are studied, substituting 1% potassium nitrate, potassium nitrite, ammonium carbonate, urea, glycine, asparagine, and White's [Witte?] peptone for the nitrogen source of the Raulin's neutral solution. Initial and ultimate hydrogen ion concentration should be recorded in these tests. In the liquid media, these authors suggest cultivation in graduated centrifuge tubes. After notes on the character of growth are taken, these tubes are centrifuged for 5 minutes at 2,000 revolutions per minute and the quantity of fungous cells at the bottom is taken as an approximate indication of the amount of growth. In the case of the sugars it is usually better to sterilize separately and add to the sterile Raulin's solution to avoid possible hydrolysis from the hydrogen ions of this solution. For the effect of different sugars on the morphology, see the interesting case of *Blastodendrion intermedium* (Fig. 38).

Production of hydrogen sulphide (Kliger's method), hydrolysis of starch (Committee method), indol production (Ehrlich method modified by Gore) may also be tried, but so far have not yielded much information useful in classification.

Finally parasitism and pathogenicity should be studied on experimental animals.

Needless to say, this elaborate and ideal method has not been carried out for most organisms so far described in this group. It is often impossible to identify recently studied strains with older species in the literature, owing to the total lack of characters used by one author in the description by another. This is especially notable in the case of Castellani, who early abandoned any mention of morphology and relied wholly on fermentation and enzyme reactions. The validity of fermentation reactions has been much discussed in recent years (for general criticisms see pp. 63, 64), often without much apparent realization of the meaning of results or the limitations of the methods employed (e.g., Castellani 1933). Under Castellani's influence, very little attention has been paid to morphology until very recently, although we have occasional attempts to correlate morphology and fermentation reactions; e.g., Fineman (1921) Nye, Zerfas & Cornwell (1928), Mackie & Chitre (1928). Recently the pendulum seems to be swinging the other direction, and we have Milochevitch (1929), Talice (1930), Shaw (1931), and Langeron & Talice (1932) emphasizing morphology very strongly, and searching for media which will produce normal mycelium rather than sprout mycelium, and in the case of myself and my students (Rewbridge, Dodge & Ayres 1929, Moore 1933-1935 and much unpublished data) rather successful search for sexual or perfect stages has removed several organisms from the imperfect stages and placed them in the Eremascaceae. Since some of these researches have much biologic interest for those attempting to determine morphogenetic factors, they may be summarized in more detail.

Marantonio (1893) working with a thrush organism found that sprouting occurred almost exclusively on solid media with occasional hyphae in old cultures. On liquid media he found mycelium either in the pellicle or in the granular deposit that appeared without turbidity. The lower the pH, the greater the quantity of mycelium found. These observations were confirmed and extended to a large number of media by Concetti (1900).

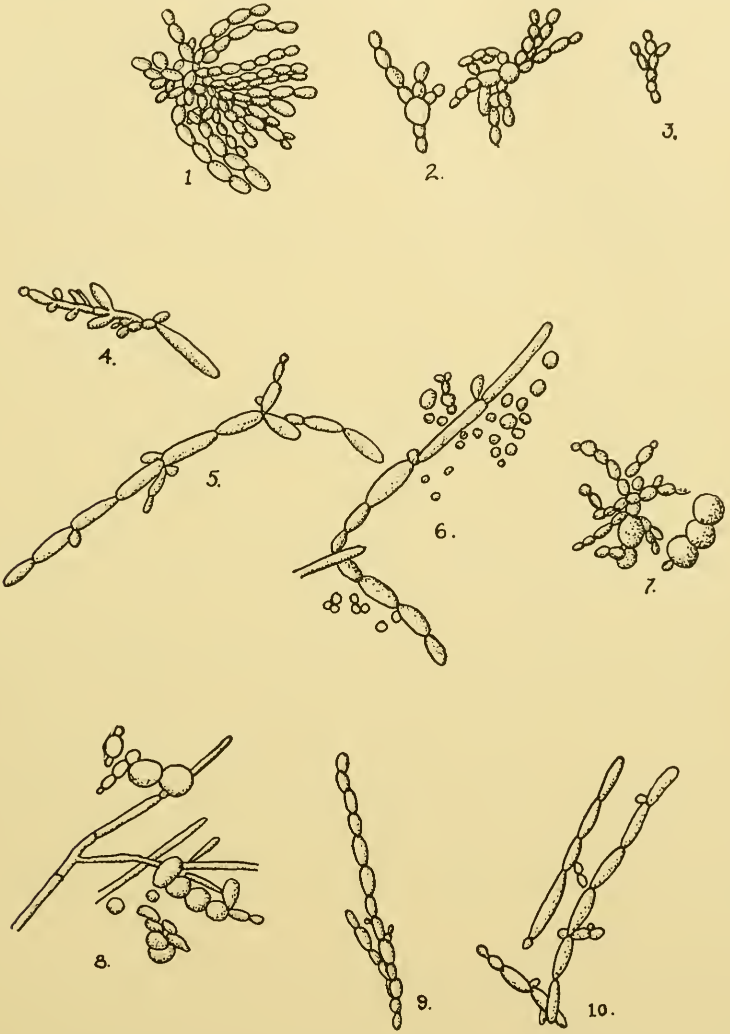

Fig. 38.—*Blastodendrion intermedium.* Showing the effects of various sugars on the morphology. *1*, glucose; *2*, starch; *3*, galactose; *4*, maltose; *5*, lactose; *6*, raffinose; *7*, inulin; *8*, erythritol; *9*, mannitol; *10*, asparagin. (After Ciferri & Ashford 1929.)

Fineman (1921) working with 17 strains isolated from cases of thrush and supposed to be *Monilia albicans*, finds the fermentation reactions constant. Mycelium develops in liquid media, in complex carbohydrate media, in media under low oxygen tension, and with low surface tension, while the yeast form predominates on solid media, simple carbohydrates, abundant oxygen and high surface tension.

Milochevitch (1929, also working with strains isolated from cases of thrush and supposed to be *Monilia albicans*, reports mycelium formed on media with higher surface tension and that the hydrogen ion concentration does not influence mycelium formation. He used a large number of animal tissues and extracts, and reported good growth on liver agar and blood, kidney and spleen agar, broth, kidney and lung broth. Growth was poor on peptone solution, brain, thyroid agar, urine, thyroid broth, ox gall and Raulin's solution.

Talice (1930) undertook an extensive study of the media and conditions favoring the formation of hyphae, using a very wide variety of media and 30 strains of various species of *Monilia*. On solid media hyphae were produced in the first day or two; the yeast forms predominate afterward, hyphae being formed only in contact with the agar. In species which seldom form hyphae, dextrin peptone media or glucose media give short periods of hyphal production, as also to a less extent do protein media. He found no advantage in semisolid media (0.1% agar) over liquid media in the production of hyphae. Hyphae develop best in liquid media, at least at first. Trying a large number of decoctions, he concluded that he obtained the best growth with dilute potato decoction. In cultures which have been grown for a long time on solid media, as many as three transplants may be necessary to secure hyphae. Tessier (1890) reported that relatively high acidities favor hyphal production, but Talice states that this varies greatly with the species, probably accounting for some of the conflicting results by earlier workers. Lowered oxygen tension favors hyphal production to a certain point. Higher temperatures, as 37° C., produce the same results. Surface tension is important, as reported by Hahn & Junker and by Milochevitch, but again this varies with the species. The dictum of Roux & Linossier in the case of their strains of *Monilia albicans* that complexity of morphologic structure increases with molecular weight of the substances in the culture medium does not hold in this group. Talice regards the yeast form as senescent.

Shaw (1931) suggests the morphology on dextrose agar and gelatin stabs (i.e., the diameter of the hyphae, length of cells, size and position of moniliform clusters, and shapes of spores) is important in separating species and species groups. Pijper had previously noted that the creamy or membranous character of the giant colony is correlated with other characters, but Langeron & Talice first emphasized its fundamental importance.

The most complete consideration of morphology so far produced is that of Langeron & Talice (1932). They emphasize the distinction between creamy and membranous colonies, the former producing abundant sprout mycelium while the latter do not, although the hyphae easily break apart in plane sections into arthrospores whose ends never become rounded. The creamy cultures are moist and shining at least in the first weeks, while the membranous colonies are dry and dull.

The characters of these two major groups may be distinguished as follows:

CREAMY TYPE	MEMBRANOUS TYPE
Rarely folded, only when the growth is very rapid.	Surface soon folded, soon velvety or studded with coremia.
Consistency of thick paste, easily adhering to the needle but never viscid, easily separating from the substrate.	Consistency viscid, not adhering to needle, or if adhering drawing out in a long thread, more adherent to the medium.
Yellowish or brightly colored.	Dull grayish white.
Forming flocculent deposits in potato decoction but no pellicle.	Forming less coherent flocculent deposits on potato decoction and usually a thick highly developed pellicle.
Giant colony thick, convex, surface smooth, shining humid, uniform or with slight furrows, center often conic, margins lobulate.	Giant colony thick, dull, flat folded, furrowed, with coremia, margin not lobed.

Two intermediate groups may be characterized in the creamy type. In *Mycocandida,* the thickness of the colony is variable, surface smooth or curdled, shining, or even iridescent, often transparent when young; surface may be somewhat folded, yellowish white, growth slower and colony diameter less than in the typical creamy type. In *Blastodendrion* colony thin and with deep radial furrows with a central eminence, surface smooth and dull.

The sprout cell or blastospore is the fundamental element of the creamy group. In general, the shape is characteristic of the genus, but one may often find many variations in a given culture (Fig. 39). They may be characterized as spherical, short ellipsoid, long ellipsoid, ovoid, or long ovoid. (In examination of material one should be sure that the cells have their longest axis approximately at right angles to the line of vision, or a long ellipsoid cell may appear short ellipsoid or even subspheric.) Then we have an asymmetrical form in *Geotrichoides,* an intermediate genus with membranous colonies. The pyriform type (stalagmoïde) often suggesting drops or tears is characteristic of *Blastodendrion.* Of the elongate types, cylindric and clavate are common. Sometimes they are somewhat irregular in development, producing allantoid and other irregular shapes.

The various stages in the development of the cell have been clearly described by Shrewsbury for *Hansenula* (*Willia*), and probably his observations might be extended to the groups covered by Langeron & Talice. The young cell is small, ovoid, spherical, or allantoid with a thin wall and a refractile, homogeneous cytoplasm (Fig. 40, *1*). Sprouting is active, the sprout cells being exactly like miniature mother cells. In each a small refractile corpuscle is visible near the center of the cell. The nature of this body is uncertain, as it could not be identified in fixed preparations and was not stained by vital stains.

As growth progresses, the young (adolescent) cell enlarges and the cytoplasm becomes more granular (Fig. 40, *2*). Vacuoles appear, generally only one per cell, but more may form in elongate cells. The vacuole soon enlarges to occupy about one-half the cell volume. Small, highly refractile bodies exhibiting active Brownian movement appear within the vacuoles. These are probably metachromatic corpuscles. Sprouting is still active and the sprout cells may or may not show vacuoles before separation from the parent cells. These adolescent (mote cells of Shrewsbury) cells correspond to the phase of maximum growth; thereafter the cells begin to store up glycogen preparatory to production of sexual processes or of hypnospores.

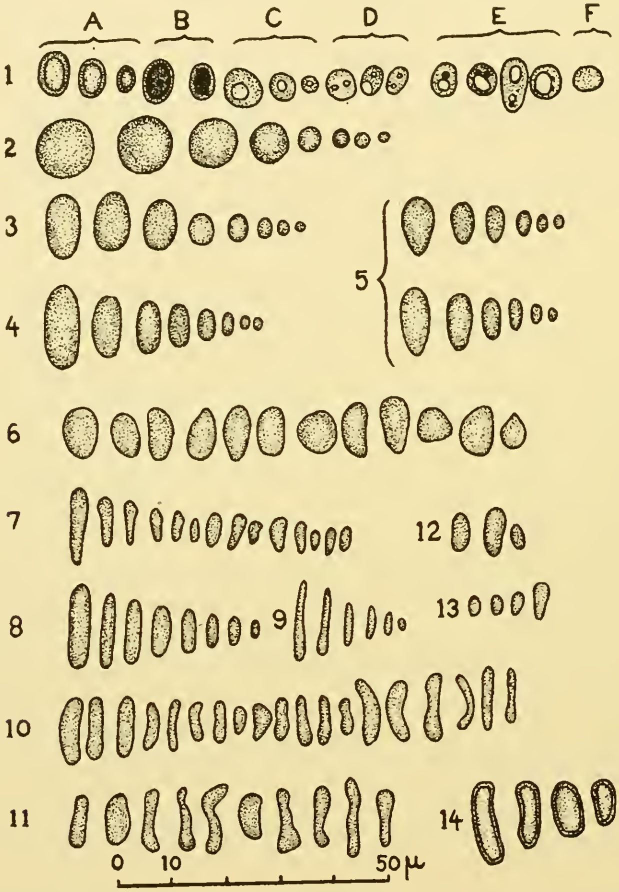

Fig. 39.—Types of blastospores. *1,* Structure: *A,* thick-walled; *B,* stained for glycogen; *C,* uniguttulate blastospores; *D,* biguttulate blastospores; *E,* showing refringent granules; *F,* degenerating senescent blastospore. *2,* Spherical blastospores; *3,* ellipsoid, short; *4,* long ellipsoid; *5,* ovoid types; *6,* asymmetric; *7,* stalagmoid or lacrimiform types; *8,* elongate cylindric types; *9,* bacilliform types; *10,* irregular bacilliform types; *11,* still more irregular types from membranous cultures; *12,* truncate types; *13,* pyriform types; *14,* arthrospores. (After Langeron & Talice 1932.)

As the culture ages, the adult cell (durable cell of Shrewsbury, Fig. 40, *3*) appears and may persist unchanged for long periods. It is larger than the preceding types. It contains a large vacuole, usually empty but occasionally containing a single fat globule. Fat is stored generally in a single large globule at one of the poles. This globule is usually surrounded by a layer of protein. Some of these adult cells are transformed into hypnospores. The cell appears dark in color, often slightly larger than the other cells, the wall may not be thickened, but is usually darker in color. The cells often contain fat globules and small dark granules.

Finally the degenerate, senescent, or dead cells (shadow cells of Shrewsbury, Fig. 40, *4*) appear to be empty of contents, often with numerous fat globules in the vicinity of the ruptured cell. Other cells seem to be filled with fat globules. Perhaps the accumulation of fat reaches a stage where it cannot be utilized and causes the rupture of the wall. Occasionally these shadow cells may be artefacts caused by the mechanical rupture of young thin-walled cells which are filled with small fat globules.

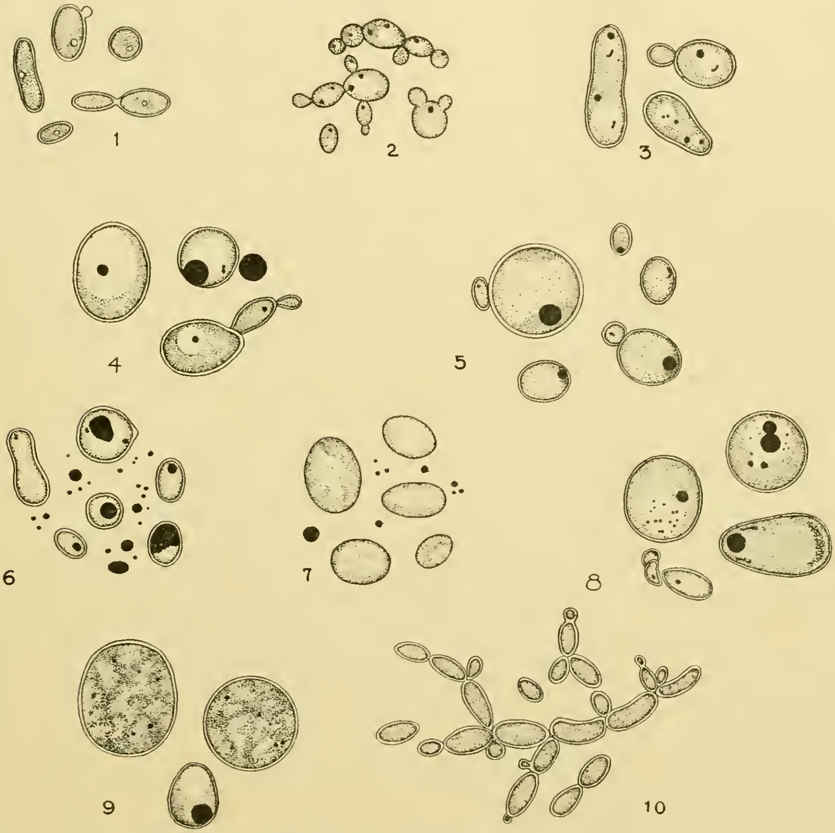

Fig. 40.—Showing Shrewsbury's cell types in *Hansenula*. *1,* young cell; *2, 3,* adolescent cells; *4, 5,* adult cells; *6-9,* senescent cells; *10,* pseudomycelium.

Sprouting may be from any portion of the cell in the true yeasts, but even among them it is often bipolar as it is in all members of the group under consideration. In very young, thin-walled cells before polarity is well established, sprouting may occur at other points. In thick-walled cells sprouting is almost always unipolar. In some genera verticils of sprouts may develop from one pole, which by proliferation, produce dichotomously or polychotomously branched chains of cells. When the branching is repeated in each cell, we have dense bushy masses forming the *arbuscules* of Ota.

After a period of sprouting, some of the mature thick-walled cells begin to develop mycelium, very much as if a spore had been formed. The cytologic changes accompanying this process are unknown. A definite slender cylindric germ tube develops instead of a subspheric sprout cell. Sometimes the septation of the hypha follows promptly on its formation, at other times the septation lags until the hypha is very long and often multinucleate. The septa may be close or distant. After a time sprouting from the mycelial cells begins, producing the sprout conidia or blastospores. Sometimes these blastospores are borne in verticils, as in *Mycotorula,* or some of the members may be rudimentary and transformed into a hyphal branch, as in *Mycocandida.*

The terminal portion of the hypha furnishes an important character. In *Candida,* the hyphae, instead of ending in a verticil as in *Mycotorula,* terminate in a chain of blastospores, which in turn may be branched but never verticillate. In *Mycocandida* and *Blastodendrion* each hypha ends in a single cell of variable length. In *Mycotorula* the hypha ends in a verticil or a dense tuft of blastospores. In *Mycotoruloides* the hyphal termination is a dense compound verticil.

Hypnospores are often terminal. They appear on liquid media and in microcultures beginning to dry up. The contents of one or more cells migrate into the terminal cell where the cytoplasm appears dense and stains deeply with Lugol's solution. The hypnospores always germinate with a germ tube.

Coremia are common in the group with membranous colonies (Fig. 3). Here the hyphae are collected into thick flexuous cords which rise perpendicular to the surface and fray out at the top. They appear on all media, even on 2% glucose. Occasionally they are seen in some of the other groups where the blastospores are long and relatively slender, but in this case they are rare on 2% glucose. Besides coremia, on malt gelatin where the colony comes in contact with the glass, one often sees long pointed strands. These are also characteristic of the group with membranous colonies.

The classification of this group presents exceedingly difficult problems. The earlier workers had very poor optical equipment and did not grow their organisms in culture. For the most part their descriptions are so brief and vague that it is very difficult to apply any of their names to organisms encountered at the present time. Since the same name early came to be used for entirely unrelated groups of organisms, we often have two or three distinct traditions for the application of a given name, the followers of each tradition claiming all the advantages of priority. To make the confusion worse, many authors have quoted incorrectly or cited dates from secondary sources. Frequently when one attempts to verify an original description, it is so different from that quoted that one can only conclude that the original description was not seen by the modern author. In the following discussions, I have attempted to present the various names in chronologic order, quoting from their original description, and tracing the various applications to various groups. It will thus be seen that practically none of the names published in the eighteenth and nineteenth centuries are legitimately available for members of this group, although many such names are in common use. There are only two alternatives, either we must abandon them altogether as has been done by Langeron & Talice, or else adopt by legislation in our code of nomenclature certain new standard species which will conserve a name in one of its traditional uses and rename all the species which do not conform to the tradition selected. By either alternative the outlook is not bright for the medical man. To adopt the first would make a break with the past and involve a renaming of many of the species, and discarding the majority as unidentifiable on account of poor description. Unless this were formally legalized by an International Congress of Botanists, there would always be trouble from the legalist, the historian, and the publicity seeker by their puerile attempts to overturn existing nomenclature in favor of their own interpretation of some older name.

If the second alternative is adopted, it must also be secured through the action of an International Congress of Botanists in which each faction would vote for the particular tradition in the application of a name to which they were accustomed, with the deciding vote held by the systematists dealing with flowering plants who would have no interest in, or knowledge of, the matter, and would decide it on national lines.

By either horn of the dilemma, action by an International Botanical Congress is necessary and one is confronted by the practical problem as to which method to adopt, pending action by such a congress, which is apt to postpone resolutions for a generation; e.g., the action on bacterial nomenclature laid on the table at Brussels in 1910 for action at the next congress has not been acted upon yet. In view of the action of the last congress at Cambridge, England, in 1930, in adopting the principle of the type species determination of the name, I have attempted to apply this principle strictly, and if the type species belongs in another genus with an older valid name, the genus name to which that type species belongs becomes a synonym of the earlier name. Where no type species can be definitely decided upon, I have adopted the view that it should be applied to the species which would produce the fewer new combinations by such applications.

MONILIA

Monilia Gmelin, Syst. Nat. 2: 1487, 1791.

Gmelin segregated as *Monilia* various species previously placed in *Mucor* and *Aspergillus*, defining the genus as "*Fila moniliformia in capitulum congregata.*" Most of the species belong to the genera *Aspergillus* and *Penicillium*, although it is almost impossible to identify them with current species. Persoon took up the genus in Neues, Mag. Bot. 1: 121, 1794 (Dispositio 40, 1797) practically repeating Gmelin's diagnosis but confining it to the erect species. He recognized four species, *M. aurea*, *M. rosea*, *M. glauca*, and *M. candida*, *M. rosea* being described and figured by Batsch, the other three by Micheli. The latter belong in *Aspergillus*, where Micheli originally placed them. *M. rosea* Batsch is probably *Trichothecium roseum.* Consequently, we may eliminate these early uses of *Monilia* as having no nomenclatorial value, unless preventing a later usage. Persoon, in his Syn. Meth. Fung., divides the genus into three groups of which the first two refer to *Aspergillus* sp. with radiate heads (with a slight admixture of other things) and those with columnar heads; while the third refers to *Torula* which he had already defined earlier as a separate genus and which he later regarded as separate. In his Myc. Eur. 1822, Persoon uses *Monilia* as a synonym of *Aspergillus.* Link used *Monilia* in the sense of and instead of *Torula.* This, however, is untenable, since by none of the rules can *Monilia* in its original usage include the dark-spored species now referred to *Torula* and *Dematium.*

Fries, in the *Systema*, uses *Monilia* as practically a straight synonym of *Penicillium.*

Bonorden (*Handbuch* 1851) defines *Monilia* in practically the same terms previously used to define *Oidium*, treating *Monilia candida* from rotten wood as the type of the genus, and describing *M. cinerea* from rotting cherries as new. Saccardo includes the type of *Oidium* in his genus *Monilia* which includes both saprophytes and parasites of plants. Therefore none of the usages of *Monilia* except that of Bonorden in the first century of its history is acceptable in the modern sense.

Geiger (1910) considered *M. candida* Bonorden as the type of the genus and separated *Pseudomonilia.*

Vuillemin (1911) correctly renamed *Monilia candida* Bonorden non Pers. as *M. Bonordeni* Vuillemin, since the former name was preoccupied. He proposed to accept the name *Monilia* in the sense used by Bonorden, which contains two species which are not generally considered congeneric. Berkhout (1923) proposed to retain *Monilia fructigena* Pers. (closely related to, if not the same as, Bonorden's *M. cinerea*) as the type of *Monilia,* and described *Candida* as new, to include the saprophytic and human pathogens, taking as her type *Monilia Bonordeni* Vuillemin or *M. candida* Bonorden.

In view of the very complicated and varied usage of *Monilia,* only two courses are open, to disregard the name altogether, which in many ways would be the simplest, or to fix its usage by adopting it as a *nomen conservandum* at an international congress in one of the senses as used by later authors. This would probably best be done by fixing *Monilia candida* Bonorden as the type species. This species was not only considered by Bonorden as the type of the genus to which he added *M. fructigena* as a new species, considering his *M. candida* the same species as that of the earlier authors (probably incorrectly), but also this procedure would conserve the name for very many species widely used in fermentation and medical literature. Some plant pathologists have attempted to typify *Monilia* by *M. fructigena* Bonorden, which belongs to a wholly unrelated group of fungi, in utter disregard of all the fundamental principles of nomenclature and, like the prophets of Baal thinking to be heard by their loud cries, have convinced such well-known mycologists as Langeron & Talice.

OIDIUM

Oidium, Link, Mag. Ges. Naturf. Freunde Berlin 3: 18, 1809.

Link characterizes this genus as "*Thallus e floccis caespitosis septatis, ramosis, decumbentibus; apicibus articulatis; articulis in sporidia secedentibus. Thallus e floccis complicatis, sporidiis inspersis magnis, ovalibus, ita ut Sporothricho aut Geothricho affine credideris genus. Cum vero accurate inspexeris floccos, invenies apices articulatos, articulosque separari et thallo inspergi. Unico species, colore pulchre aureo, Oidium aureum* (*Trichoderma aureum* Pers.)." The figure shows a habit very similar to *Geotrichum,* but the arthrospores are ellipsoid. Persoon, Syn. Meth. Fung. had described the fungus "*late effusum, villo subalbido, tenuissimo, pulvere obscure flavo. Provenit rarius in vaporariis ad ligna cariosa, cui immersum.*"

Link in his revision of the fungi in Willdenow's edition of Linné, *Species Plantarum* 6: 121, 1824, recognizes 10 species, of which *O. virescens* and *O. Uredinis* are described as new, the rest being transfers from other genera, mostly *Acrosporium* and *Monilia.*

There seems no reason to take *Oidium monilioides (Acrosporium* Nees) on the underside of grass leaves as the type of *Oidium* and consider it a plant parasite, as has been done by Jaczewski and others.

Fresenius (1851) introduced confusion by his *Oidium lactis.*

GEOTRICHUM

Geotrichum, Link, Mag. Ges. Naturf. Freunde Berlin 3: 17, 18, 1809.

This genus was first characterized: "*Thallus e floccis caespitosis septatis, ramosis, decumbentibus. Sporidia ovalia, utrinque truncata, inspersa. Thallus e floccis complexis. Sporidia magna, extremitatibus truncatis genus designant. Affine genus Sporothrico, at sporidiis sat differt.*" *Geotrichum candidum* was the only species recognized: "*caespitibus effusis, floccis albis, sporidiis concoloribus. Tenuis instar tomenti terram in sylvaticis sterilibus et ericetis obtegit, maculam albam nudo oculo granulosam efficiens. Plantula fugax.*" The figures show a septate mycelium with cylindric arthrospores.

In 1824, in his revision of the fungi of Willdenow's edition of Linné's *Species Plantarum,* Link includes it in *Botrytis* under the name *Botrytis geotricha.* Persoon includes *Geotrichum* in his *Mycologia Europaea,* 1822, without comment. Saccardo (1886) recognized the genus, placing the earth-inhabiting species in *Eugeotrichum* and the coprophilous species in *Coprotrichum.*

Loubière (1924) has revived it in connection with his studies of organisms in cheese.

MYCODERMA

Mycoderma Persoon, Mycologia Europaea 1: 96, 97, 1822.

The type species is *Mycoderma mesentericum* Persoon.

The genus was first described as "*orbiculare, coriiforme, primo molle, subpellucidum dein induratum, substantia ubique aequali (Aspermum? natura Mucedinum).*" It included four species evidently forming pellicles on various sugar-containing liquids. *M. mesentericum,* from a bottle imp of wine, produced a folded white, viscous pellicle; it had been previously described but not named in Persoon, *Traité des Champignons Comestibles* 8, 1818. *M. lagenae,* also from wine, was smooth, obsoletely rugose below, and reddish. *M. ollare* on a decoction of *Rumex acetosella* produced a deeply folded, fuscous to bay, rather fragile pellicle. *M. pergameneum* produced a thin white pellicle with a rough surface.

While I have been unable to locate a copy of the work, Demazières in his *Catalogue des plantes omises dans la botanographie belgique et les flores du nord de la France,* Lille 1823, is said to have renamed *M. mesentericum* and *M. lagenae* as *M. vini* (p. 13) and described *M. cerevisiae* (p. 13). Shortly thereafter he issued his *Plantes cryptogames du nord de la France* [probably a collection of specimens with descriptive labels, but not seen] in which No. 101 was *M. cerevisiae,* No. 102 was *M. malti-juniperini,* described as new, and No. 103 was his *M. vini.* By 1825 he had prepared cultures of this genus by exposing shallow dishes of beer, wine, etc., to the air and produced several cultures with pellicles. These he studied microscopically and finding flagellates as well as fungus filaments, confused the literature for a long time by trying to fit them into a single life cycle. This was published as his *Observations botaniques et zoologiques,* Rec. Trav. Soc. Amateurs Sci. Agr. Arts Lille 1825: 1826 [the portion on *Mycoderma* reprinted in Ann. Sci. Nat. I, 10: 42-67, *Pl. 3* 1827]. In this work he recognizes *M. cerevisiae, M. malti-cerevisiae, M. malti-juniperini, M. vini, M. glutinis-farinulae,* and *M. vini* Vallot (Bibl. phys. econ. août 1822). A study of Desmazières' figures shows that he was not working with pure cultures. *M. malti-juniperini* seems to be made up of filaments dissociating into cylindric cells such as are found in the milk organism, *Geotrichum lactis. M. vini* is mostly bacterial? with some dichotomous hyphae, rather sparingly septate and sterile; *M. glutinis-farinulae* is a branched moniliform chain of ellipsoid cells, while *M. cerevisiae* is made up of cells which may belong to as many as four different organisms: *Saccharomyces cerevisiae, Geotrichum lactis,* a species with septate, dichotomous, sterile hyphae, and branched chains of moniliform cells similar to *M. glutinis-farinulae* but much smaller.

From the preceding discussion it seems clear that *Mycoderma* should be retained for organisms forming a viscous pellicle on the surface of solutions rich in sugars. During the rest of the nineteenth century various heterogeneous elements were included in this genus. According to Jannin (1913) Vuillemin decided to typify the genus by *M. malti-juniperini,* being either ignorant of, or ignoring, the earlier description of both Persoon and Desmazières, and thus fixing the name as a synonym of *Oidium lactis* Fresenius (since shown to belong in *Geotrichum*). Most French writers have followed Vuillemin blindly. Enlows (1920) would typify the genus by *M. ollare,* since it is the first on the page on which *Mycoderma* was described.

In the brewing and wine industry, the tradition has been strong to make *M. vini* and *M. cerevisiae* the typical species of the group, although they have been differently characterized by different workers. Unfortunately they have been more interested in the products of fermentation than in the agents involved, so that much important information lies buried in a mass of fermentation studies. Leberle (1909) and Will (1910) illustrate this tradition, and define the genus as follows: In young cultures, cells cylindric, ends not rounded; in old cultures, elongate cells, spherical and ellipsoid cells often present in groups; few or no chains of sprout cells; cells oily, with air bubbles. Growth rapid and in a short time covering alcoholic solutions with a thick pellicle, with radial ridges running to within 2 mm. of the periphery; giant colonies yellowish, dull; gelatin not liquefied.

SPORENDONEMA

Sporendonema Desmazières, Ann. Sci. Nat. **11**: 246-249, *Pl. 21*, 1827.

This genus is apparently closely related to *Geotrichum* or *Mycoderma*, both of which antedate it. It was described from colonies on cheese as follows: Hyphae short, simple or branched, not septate, almost hyaline, grouped, about 8μ in diameter, containing very large reddish spores, often crowded and compressed but in a single line so that the hyphae appear closely septate. Dissemination either from the tips or by the destruction of the thin hyphal walls. The free spores are hyaline. The plate shows short filaments apparently of the *Mycoderma* type breaking up into arthrospores, but some portions of the filament remain sterile. Duby, *Botanicon Gallicum* [Candolle, *Bot. Gall.* ed. 2] 925, 1830, recognizes the species and states that specimens were distributed ''crypt. exs. n. 161,'' but I have not yet been able to locate and study these specimens. Corda, Icones Fungorum 2: 8, 1838, was unable to confirm Desmazières' observations, but it is not clear whether he actually saw a specimen from Desmazières or whether he was studying some other common organism on Dutch and Swiss cheeses, as he states that the organism is common on these cheeses. Corda certainly figured some species of *Mycoderma,* although he referred the organism to *Torula.* Berkeley & Broome, Ann. Mag. Nat. Hist. II, 5: 460, 1850, renamed the organism as *Torula Sporendonema,* reporting it from rat dung and stating that it was the same as the organism distributed by Mougeot & Nestler, No. 998. Oudemans, Verslag. Mededeel. K. Akad. Wetens., Afd. Natuur. III, 2: (115)-(122), *1 pl.,* 1886, revived the name for another species which fitted the generic description of Desmazières, although it does not seem related to Desmazières' original species.

More recently Ciferri & Redaelli (1934) and Redaelli & Ciferri (1934) have used the name for wholly unrelated organisms of which *Hemispora stellata* (p. 183) and *Scopulariopsis D'Agatae* (p. 649) are probably human pathogens.

OOSPORA

Oospora Wallroth, Fl. Cryptog. 1: 182-184, 1833.

This genus combines *Oidium* Link, *Oideum* Schlechtendal, *Acrosporium,* Nees, Sprengel, and Persoon, *Alysidium* Kunze. It includes also the species on rosaceous fruits now commonly referred to *Monilia* Berkh. non Bonorden. Both light and dark colored species are included so that *Torula* and *Dematium* and perhaps *Trichoderma* belong here as well. Consequently the genus is made up of such diverse elements that it should be dropped altogether. The use by Saccardo is practically synonymous with the original use of *Oidium.* The usage of several modern French writers is practically synonymous with *Actinomyces.*

GLYCYPHILA

Glycyphila Montagne in Payen, C. R. Acad. Sci. 33: 393-397, 1851.

This genus was based on two species, *G. erythrospora* (Champignon rouge du sucre Mirbel & Payen, Mém. Acad. Sci. 22: 6, *Pl. 1 bis,* 1845) and *G. elaeospora.* These two species were united under the name *G. versicolor* by Montagne (Bull. Soc. Nat. et Centr. Agr. 462, 1852) and so treated by him in his Syll. Gen. Sp. Pl. Cryptog. 307, 1856. The genus was described as follows: Hyphae arachnoid, hyaline radiating from a common center, very much branched, septate, repent, constricted; branches dichotomous, attenuated, including seriate? spores; spores not easily liberated, spherical, at first rose color then olivaceous, conglomerate, held together by a gelatinous sheath when young. While the relationships of this genus are not clear, I think there is little relationship with *Hemispora* as suggested by Ciferri & Redaelli (1934). Only a study of a similar organism from a similar habitat or of Montagne's microscopic preparations, if they still be in existence, can solve its relationship.

SYRINGOSPORA

Syringospora Quinquaud, Arch. Physiol. Norm. Path. 1: 290-305, *Pl. 8*, 1868.

The type species is *Syringospora Robini* Quinquaud, which is based on *Oidium albicans* Robin. If this species is to be removed to a segregate of *Monilia, Oidium*, etc., this genus name must be used rather than *Mycotorula, Parasaccharomyces*, etc., as has been done by recent authors. For example, since Langeron & Talice give this species as the type of *Mycotorula, Syringospora* must be used instead of *Mycotorula* in their classification. Whether *Mycotorula* Will is a synonym, must rest on one's decision as to whether his type species is congeneric with *Syringospora albicans (Oidium albicans* Robin).

Mycelium septate, dichotomously or trichotomously branched, the spores borne in dense tufts on very short lateral branches. Hyphae 2-5μ in diameter; blastospores ovoid 3-7μ in diameter, germinating with germ tube or by sprouting.

The figure shows dense terminal cluster around a short lateral branch no larger than a spore.

ENDOBLASTODERMA

Endoblastoderma Fischer & Brebeck, Zur Morph. Biol. Syst. Kahmpilze, etc., 1-52, *2 pls.*, 1894.

Type species not mentioned. Three species, with several varieties each are treated: *E. amycoides, E. liquefaciens*, and *E. glucomyces*. *E. amycoides* var. I. is said to be the same as *Mycoderma cerevisiae* Hansen, isolated from lager beer.

This genus was based upon a misconception that the cells were formed endogenously. From the description it seems likely that the large oil globules of senile cells were observed. These are easily liberated from the mother cell by crushing. The authors emphasize that the genus includes only those species in which the pellicle is promptly and regularly developed. No ascospores formed.

There seems little to differentiate this genus from *Mycoderma*.

ZYMONEMA

Zymonema Beurmann & Gougerot, Tribune Méd. 42: 503, 1909.

The type species are *Zymonema Gilchristi (Blastomyces dermatitidis* Gilchrist) and *Z. Sakurani*. The authors also intended to include *Coccidioides immitis*, although they do not mention it by name. Later they state that both *Z. Sakurani* and *C. immitis* are aberrant and of doubtful position. Hence, after excluding these two species, we must assume *Blastomyces dermatitidis* is the type of the genus. Since asci have subsequently been found in that species we must transfer *Zymonema* to the Eremascaceae (see p. 165).

Beurmann & Gougerot characterize *Zymonema* as follows: Thallus a mixture of spherical or ovoid sprout cells, septate, branched hyphae and short chains of sprouting ovoid blastospores. Conidia are catenulate and branched. Arthrospores in chains at the ends of hyphae. No asci observed.

PARENDOMYCES

Parendomyces Queyrat & Laroche, Bull. Mém. Soc. Méd. Hôp. Paris, III, 28: 111-136, 1909.

Type species: *Parendomyces albus* Queyrat & Laroche.

Colony creamy, mycelium scanty, limited to short chains in liquid media, cells ellipsoid; chlamydospores abundant; ascospores not seen. Pellicle formation rare, rings more common on liquid media; gelatin not liquefied; milk coagulated.

PARASACCHAROMYCES

Parasaccharomyces Beurmann & Gougerot, Tribune Méd. 42: 502, 1909.

The type species is *Parasaccharomyces Sambergeri* Beurmann & Gougerot based upon *Pseudosaccharomyces Bussei* Šamberger, *Sbornik klinicky* 5: 466-485, *Pl. 6*, 1904.

Colony creamy, hyphae straight, long; yeast cells ellipsoid thick-walled; ascospores not seen. No pellicle but ring with aerial hyphae; gelatin liquefied; glucose fermented.

PSEUDOMONILIA

Pseudomonilia Geiger, Centralbl. Bakt. II, 27: 97-149, *2 pls., 4 figs.*, 1910.

No type mentioned, four species described as new. Since *Ps. cartilaginosa* and *Ps. mesenterica* are mentioned as differing in some respects, they may not be considered as type. Consequently we have to choose between *Ps. albomarginata* and *Ps. rubescens*, both of which are about equally eligible. Since *Ps. rubescens* is the only distinctly colored species, it seems wise to consider *Ps. albomarginata* as the type.

Cell shape variable in young cultures, sprout cells in old cultures. More or less branched mycelium without true septa develop from the sprout cells. Giant cells common in old cultures. Strong surface growth, very little deposit. Giant colony similar to *Monilia candida,* formation of shaggy tufts. No ascospores. No alcoholic fermentation, sugars variously assimilated.

Separated from *Monilia* which he typifies by *M. candida.*

ENANTIOTHAMNUS

Enantiothamnus Pinoy apud Brault & Masselot, Ann. Derm. Syphiligr. V, 2: 592-602, 1911.

The type species is *Enantiothamnus Braulti.*

Pinoy has described and figured this genus very well. It has many of the characters which Langeron & Talice ascribe to *Blastodendrion,* but it is probably a synonym of syringospora (see p. 277).

PROTEOMYCES

Proteomyces Moses & Vianna, Mem. Inst. Oswaldo Cruz 5: 192, *Pls. 14-18, Fig. 2,* 1913.

The type species is *Proteomyces infestans* Moses & Vianna.

Yeast cells pyriform, germinating by germ tubes which become septate and produce thick-walled chlamydospores [or arthrospores]. These in turn germinate by hyphae which are highly developed; colonies powdery in the center, furrowed; pellicle formed; gelatin liquefied, milk clotted; no fermentation.

MYCOTORULA

Mycotorula Will, Centralbl. Bakt. II, 46: 226-281, 1916.

The type species is *Mycotorula craterica* Will. *M. radioplicata* was also described at the same time and neither designated as the type by Will.

Sprout mycelium, unbranched or branched, composed of elongate cells, never forming coenocytic or septate mycelium. Blastospores spherical or ellipsoid, separating from the parent hypha and reproducing by sprouting, forming short unbranched or branched chains, never crowns. Pellicles are usually promptly formed on liquid media, in which sprout cells usually predominate. Giant colonies flat, smooth, with a wavy, more or less regular margin, usually with a crater formation or shallow radial furrows, often with bundles of hyphae penetrating the substrate. Gelatin rapidly liquefied. Sugars fermented. Organic acids easily assimilated, acids formed in most sugar-containing media. Ethyl alcohol assimilated. No pigment formation, fluorescence, or odor. Hydrogen sulphide produced in mineral nutrient solutions containing powdered sulphur.

PSEUDOMYCODERMA

Pseudomycoderma Will, Centralbl. Bakt. II, 46: 278-281, 1916.

The type species is *Pseudomycoderma vini* Will.

Cells fusiform, with 1-3 oil globules, shorter cells citriform suggesting those of *Pseudosaccharomyces,* also small spherical cells with a single oil globule. Pseudomycelium branched, of long slender cells, terminal portions of the branches not forked. Pellicle developing rapidly on malt extract, at first small islets, resembling a drop of fat, then confluent, but still showing the points of union of the separate islets, the upper portions becoming chalk-white, gas bubbles collecting under the pellicle. In old cultures the pellicle is compact and tough, brownish or slightly reddish. On other liquid media, the islets are rapidly confluent, the pellicle is vigorous, smooth, white and glassy, easily sinking to the bottom. Colony folded, center crateriform, upper portions of the fold chalky. Gelatin slowly liquefied; sugars fermented; hydrogen sulphide produced in mineral nutrient solutions to which powdered sulphur is added.

CANDIDA

Candida Berkhout, De Schimmelgeslachten Monilia, Oidium, Oospora en Torula 63, 1923.

Geotrichoides Langeron & Talice, Ann. Parasitol. Hum. Comp. 10: 62-69, 1932.

This genus was based on the group of animal parasites which had previously been placed in *Monilia* Bonorden. Its type species was *Candida vulgaris* Berkhout (*Monilia candida* Bonorden and *Monilia Bonordeni* Vuillemin.) Unfortunately Berkhout, while renaming *M. candida* Bonorden to avoid a reduplicating binomial *(Candida candida)* in accordance with the international rules, overlooked the fact that *M. Bonordeni* was a synonym and must be used. The correct name, therefore, should be *Candida Bonordeni* (Berkhout) Dodge n. comb.

Langeron & Talice (1932) commit a grave error, when dismembering this genus as conceived by Berkhout, in not retaining *C. Bonordeni* as the type species, but placing this species in *Geotrichoides* and making *Candida tropicalis* (Castellani) Langeron & Talice the type of this genus. Consequently the only course open is to reduce their *Geotrichoides* to synonymy with *Candida* Berkhout, and to find a new name for the group which they call *Candida.* Such nomenclatorial changes are very unfortunate and should be avoided.

The genus was characterized by small, ovoid, or spherical conidia arising by sprouting from the cells of reduced hyphae; conidia germinating by sprouting or by germ tubes. Sugars fermented. Mostly pathogenic on man.

Langeron & Talice characterize their *Geotrichoides* as follows: Colonies membranous, thick, radially folded or areolate, with tufts of hyphae giving the colony a dull velvety appearance; margins not lobulate, blastospores often thick-walled, similar to arthrospores, others ovoid or irregular, sometimes pyriform and suggesting conidia, often very large [7-10μ]. Pseudomycelium well developed, hyphae little branched, flexuous, not easily breaking apart, ends of cells flattened, cells filled with fine oil globules. Terminal cell of hypha variable, often a chlamydospore of variable form, rarely a chain of chlamydospores; coremia abundant; verticils more or less regular, composed of a few pyriform blastospores.

Langeron & Talice made *Monilia krusei* Cast. the type of their genus *Geotrichoides,* but since they claim that the type culture of *Candida vulgaris* Berkhout is congeneric with this species, *Geotrichoides* falls into synonymy with *Candida* Berkh. excl. syn.

MYZELOBLASTANON

Myzeloblastanon Ota, Derm. Woch. 78: 216-237, 260-264, 1924.

No type species was designated in the original description which is very difficult to interpret. The author states that he is proposing the genus to cover the blastosporic species of *Monilia* and immediately proceeds to divide it into three subgenera. He then uses specific names with his subgeneric names as if he considered them genera and *Myzeloblastanon* as a tribal designation, making the combinations *Blastodendrion Krausi, B. Arzti, Myzelorrhizoides cutaneum,* and *M. Gruetzi.* When he next treated the genus monographically in his *Champ. Paras. Homme* (1928), he no longer recognized his subgenera and combined all his species under the name *Myzeloblastanon.* Should we consider *Myzeloblastanon* validly published in 1924? A strict interpretation of the International Rules of Nomenclature would deny such publication, as the specific epithets were not formally combined with the new generic name. The intent of the author is not clear. On the other hand, shall we accept *Blastodendrion* as validly published in 1924? The combinations of specific with generic names are formally made, but the author distinctly states that he is proposing the name as a subgenus. The intent of the author is equally doubtful. If we decide to drop both names as a permanent source of error in 1924, we are troubled equally. In 1925 Ciferri & Redaelli formally proposed *Blastodendrion* as a new genus, making the proper new combinations, but in the same year Ota proposed another species, *M. Favrei.* This latter species differs from the others in showing racquet mycelium suggestive of some species of *Zymonema* and if it be taken as the type of Ota's *Myzeloblastanon,* would exclude all the other species included in it by Ota and other Japanese workers subsequently. In 1928 Ota, in his *Champ. Paras. Homme,* treats the genus monographically, figuring several of the more important species, including *M. Krausi, M. Arzti, M. cutaneum, M. Favrei.* A study of all these species leads me to place them in *Blastodendrion* as used by Langeron & Talice (1932) who first thoroughly studied the morphology of the group, although they proposed *B. intermedium* as the standard species of their genus *Blastodendrion.*

Whether one uses *Myzeloblastanon* or *Blastodendrion* for this group of organisms, one will probably find equally careful authors using the other name, and putting forth equally sound arguments for its usage. In view of the fact that the more careful morphologic work has been done on *Blastodendrion,* while even in his later treatments Ota has still included very diverse elements, in this work I shall use *Blastodendrion* and consider *Myzeloblastanon* a synonym. For further discussion of type and description of the genus see *Blastodendrion.*

BLASTODENDRION

Blastodendrion Ota, Derm. Woch. 78: 216-264, 1924; Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, 2: 129-146, 1925.

The type species is *Blastodendrion Krausi* Ota.

Since a culture of *B. Krausi* was not available, Langeron & Talice (1932) chose *B. intermedium* Ciferri & Ashford as the type of the genus.

Ota defines *Blastodendrion* as producing a mycelium of elongate cells with dendroid masses of blastospores (*Sprossbäume* of Lindner).

Langeron & Talice describe it as follows: Colony creamy, thin, beginning from the germination of a thick-walled blastospore, forming a dendroid mass by sprouting, either bipolar or multiple, rarely cruciate; blastospores polymorphous, the lacrimiform or pyriform type predominating; pseudomycelium more or less developed, little branched, less easily dissociable than in related genera, forming dendroid masses with ascending branches parallel or suggesting the branching of sporophores in *Penicillium,* cells mostly elongate, pyriform, hyphae terminated by a chain of lacrimiform blastospores or by a long slender filament; verticils occasionally present, formed of lacrimiform blastospores.

REDAELLIA

Redaellia Ciferri, Arch. Protistenk. **71**: 424-428, *Fig. 3,* 1930; Brunetto, Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia IV, **5**: 125-143, *8 figs,* 1934.

Type species *Redaellia elegans.*

Colony growth slow, elevated, small, cerebriform, irregularly convoluted, hyphae hyaline, septate, branched with many fusiform blastospores in tufts at the tips. Blastospores germinating either by sprouting or by hyphae (Fig. 41).

SCHIZOBLASTOSPORION

Schizoblastosporion Ciferri, Arch. Protistenk. **71**: 446-448, *Fig. 6,* 1930.

The type species is *Torula A* Starkey & Henrici (*Schizoblastosporion Starkeyi-Henricii* Cif.).

Starkey & Henrici described their organism as cells variable, predominantly elongated ellipsoid. Reproduction intermediate between fission and sprouting, as in *Saccharomycodes.* Cells with numerous small fat globules which increase in numbers but do not coalesce in old cells. Agar colonies smooth, white. In glucose broth, turbidity and sediment. No fermentation of any sugars.

Ciferri adds: slight incomplete ring, margins of colony smooth, blastospores spherical, 5μ in diameter, to ellipsoid, $5\text{-}7 \times 2\text{-}3\mu$; mycelial cells elongate, cylindric, $5.5\text{-}7.5 \times 10\text{-}15\mu$, rarely to 22μ.

MYCOTORULOIDES

Mycotoruloides Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 48-54, 1932.

The type species is *Mycotoruloides triadis* Langeron & Talice.

Colonies creamy, thick, convex, beginning by bipolar sprouting of a blastospore followed by progressive branching of the pseudomycelium. Blastospores spherical or ovoid, arranged in verticils, arising at the apical portion of the pseudomycelial cells, no terminal chains of cells. Pseudomycelium formed of short cells, each cell often producing a verticil of blastospores at its apex. The verticils are less regularly spaced than in *Syringospora* and are usually compound, producing an ovoid mass of blastospores whose long axis is more or less perpendicular to the main axis of the pseudomycelium. Some branches develop much more than others, giving an irregular appearance. Occasionally a branch grows out and is terminated by short chains from its terminal verticil. Gelatin not liquefied.

MYCOCANDIDA

Mycocandida Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 56-58, 1932.

The type species is *Candida mortifera* Redaelli.

Colonies creamy, sometimes thick, more often thin, flat, iridescent, transparent at first, then forming a *glacis,* sometimes coremia present, beginning by bipolar sprouting, blastospores appearing late, dimorphous, ovoid or elongate, the latter type predominant, much less numerous than in the preceding genera. Pseudomycelium well developed, highly branched (suggesting the branching of a fir tree), hyphae ending in a group of blastospores, a short chain, or a single elongate cell. Verticils not developed, the apical portion of a pseudomycelial cell not producing more than two opposite blastospores. Gelatin not liquefied.

In this work no attempt will be made to cover the pathologic changes in tissues by these organisms, beyond very brief notes in connection with the individual species. The pathogenicity ranges from great severity with a relatively high fatality to very mild lesions. Practically all organs may be attacked. The majority of the species so far described are evidently saprophytes which have found a suitable substratum for growth and multiplication. This growth may set up a mechanical irritation, often aggravating already existing conditions, or enzymes and toxins secreted may interfere with the normal functions of the organs.

The bulk of the species quickly divides into those attacking one or more of the following organs: respiratory tract, alimentary tract, genitalia, and skin. Some of those with weaker parasitism may be found on more than one organ, while on weakened hosts they may migrate and invade organs not originally attacked.

In the respiratory tract, many of the symptoms closely simulate pulmonary tuberculosis, from which they may be differentiated by the absence of *Mycobacterium tuberculosis* in the sputum and the presence of large numbers of blastospores. A specialized form from the Orient, variously known as ''tea factory cough'' or ''tea taster's cough,'' is a bronchomycosis, supposed to be spread by the dry tea leaves which are sniffed in determining odor while grading tea. These mycoses usually disappear quite promptly following administration of relatively large doses of potassium iodide.

In the digestive tract, we find these organisms in the flora of apparently normal persons. Whether they are the same species as those which are so abundant in the tracts of diseased individuals, is still a disputed point. Too frequently all these organisms have been called *Monilia albicans*, *Soor*, *sapinho* or *muguet* without a critical study as to specific identities. A few morphologic characters, or few fermentation reactions are given, seldom both, usually neither. The two clinical entities which have gradually been differentiated are thrush and sprue. Both these conditions need much further clinical study correlated with a more careful study of the morphology of the organism.

Thrush is predominantly a disease of the mouth of infants, occasionally also of senile or very anemic persons. With weakened resistance the organism may spread to the lower digestive tract, the vagina, or even the moister portions of the skin. Apparently several different species may cause approximately the same symptoms, giving rise to no end of confusion in the literature, for each worker apparently searches for a case of thrush, isolates the organism, considers it as typical for the organism originally described by Robin, and designates it as *Monilia albicans* or by one of the numerous synonyms. A study of the drawings in the numerous doctoral theses on this disease in the last century, will indicate many different organisms which we would now place in different genera. On the other hand, some authors are still willing to assign all sorts of organisms from all types of organs and with varying degrees of pathogenicity to this species, very much as some consider various animal pathogens identical with *Saccharomyces cerevisiae,* the common beer yeast!

In sprue, the organism flourishes in the lower digestive tract accompanying, if not causing, a severe anemia which usually disappears after the organism no longer is found in the stools. This disease, mostly confined to the white migrants to the tropics, has been studied extensively in the Dutch East Indies, India, and Puerto Rico. Its etiology has been ascribed to many conditions, from climate and vitamins to fungi. It is usually more severe in the well-to-do white immigrant or native whose food is often not well adapted to a tropical climate than to the poor native. A prolonged diarrhea is followed by anemia which may prove fatal. Ashford has had success with patients following a careful diet over a long period, designed to eliminate the organism from the intestines. Since practically no worker has critically studied the disease in all three regions, it seems quite possible that similar clinical symptoms have been taken for identities. Attempts to extend the findings of sprue to pernicious anemia, which it resembles in many respects, have not been very successful. Ashford has called the common intestinal organism in Puerto Rico *Monilia psilosis* and provided it with a diagnosis which makes it include several of the species separated by Castellani on the basis of their fermentation. Others have found variants to which they either have or have not given specific names, until the number of species reported from the intestines is quite large.

A third substratum where these organisms are commonly found, includes the genitalia. They are rather rare in the urethra or about the glans, but very common about the vagina. Their action is largely a mechanical irritation resulting from small creamy colonies scattered over the mucous membranes. However, they are often difficult to eradicate by application of local antiseptics. They are especially likely to be present in diabetics, owing to the sugar in the urine which encourages their growth. Very rarely they penetrate the bladder and set up a gaseous fermentation, causing pneumaturia.

Finally, we have the skin as a possible substrate. Many species cause cutaneous or subcutaneous lesions. There are also several species which have been rather inadequately described which cause lesions closely resembling dysidrosis on the palmar and plantar surfaces and interdigital spaces, rarer in other moist situations. Such lesions are rather more common between the fingers than elsewhere and are locally known as ''Jewish washerwomen's disease.'' The greater frequency among Jews is attributed to the nonuse of soap among these women, since they fear that the animals which the fat is taken from were not slaughtered in accordance with kosher rules. Several species have been reported as attacking the nails in chronic paronychia. Members of this group have frequently been reported from cases of perlèche. Except for the infections of nails, few of the species causing the more superficial cutaneous lesions have been adequately described or named.

Undoubtedly many of the species so far described are primarily saprophytes and are present in the lesions as secondary invaders. This may account for the relatively large numbers of organisms which have not been reported more than once. On the other hand, there seem to be rapidly accumulating indications that some of the organisms of this group are primarily parasitic, or at least so profoundly modify other factors in the production of disease that they should be considered seriously in the study of the disease. It is to be hoped that with clearer ideas of morphology and physiology of these organisms and a recognition of the ability of many different species to occur in essentially the same clinical entity, we may have tools which will aid us in a more accurate delimitation of species. No really stable clinical differentiations, sound animal experimentation, or rational therapeusis can be built up until we have broader and more thorough studies of the many organisms involved. In the following systematic discussion, I have attempted to refer organisms to the various genera on the basis of their published descriptions, realizing thoroughly that only a portion of the characters are given. I have also very largely refrained from reducing species to synonymy, since I feel that the burden of proof rests with him who would reduce species rather than with the describer of new species. It is, therefore, quite probable that several species here recognized will eventually be shown to be synonymous with other species, but I feel that at the present time there are few studies sufficiently extensive and thorough upon which to base such action.

Key to Genera of Eremascaceae Imperfectae

- Mycelium breaking up into arthrospores, i.e., cells of the filaments cylindric or nearly so after separation.
  - Colony cerebriform, villous, irregular, growth slow, little or no growth on liquid media, arthrospores not very abundant. *Proteomyces.*
  - Colony membranous, folded, dull, usually grayish white.
    - True mycelium not fragile before disarticulation of arthrospores, no blastospores; thick pellicle on liquid media, sugars not fermented.
      - Gelatin liquefied. *Geotrichum.*
      - Gelatin not liquefied. *Mycoderma.*
    - Pseudomycelium fragile, conidia and transitional forms between blastospores and arthrospores present.
      - Gelatin not liquefied, no pellicle on liquid media, although occasionally a partial ring formed.
        - Blastospores verticillate, sugars fermented. *Candida (Geotrichoides).*
        - Blastospores single, sugars not fermented. *Schizoblastosporion.*
      - Gelatin liquefied, chalky-white to yellowish pellicle on liquid media, cells long fusiform or apiculate, sugars fermented. *Pseudomycoderma.*
- Arthrospores not produced, blastospores abundant and characteristic, colony creamy, yellowish white, shining.
  - Pseudomycelium little branched, blastospores not in verticils nor in regular pairs at the ends of pseudomycelial cells; cells ellipsoid.
    - Gelatin not liquefied, no pellicle, although rings are sometimes produced.
      - Sugars not fermented. *Parendomyces.*
      - Sugars fermented. *Castellania.*

- Gelatin liquefied, sugars fermented.
    - No pellicle. *Parasaccharomyces.*
    - Pellicle produced. *Mycotorula.*
- Pseudomycelium branched, blastospores in chains, verticils or pairs at the ends of pseudomycelial cells.
    - Blastospores apical only.
        - Blastospores isolated or in apical verticils, fusiform, colony cerebriform; sugars not fermented. *Redaellia.*
        - Blastospores in long chains, rarely ever verticillate, ellipsoid; gelatin not liquefied. *Monilia.*
    - Blastospores both terminal and lateral, never in long terminal chains, sugars fermented.
        - Verticils simple, regular, often in terminal tufts, gelatin liquefied, very thin pellicle on malt extract or none. *Syringospora.*
        - Verticils either simple or compound, more or less regular, not terminal; gelatin not liquefied.
            - Blastospores lacrimiform or pyriform, mostly in dendroid clusters, colony dull. *Blastodendrion.*
            - Blastospores spherical or ovoid, verticils compound, elongate. *Mycotoruloides.*
            - Blastospores elongate-ellipsoid, verticils rudimentary, reduced to two blastospores each, colony folded.
                - Colony moist, shining. *Mycocandida.*
                - Colony dull, pellicle present, no sediment, no fermentation. *Pseudomonilia.*

Artificial Key Based Largely on Biochemical Characters

- Colony cerebriform, sugars not fermented.
    - Arthrospores produced rarely, gelatin liquefied. *Proteomyces.*
    - Blastospores fusiform, terminal verticils. *Redaellia.*
- Colony membranous, wrinkled or much folded, grayish white, arthrospores present.
    - Gelatin liquefied.
        - Sugars fermented, pellicle produced. *Pseudomycoderma.*
        - Sugars not fermented. *Geotrichum.*
    - Gelatin not liquefied.
        - Sugars fermented. *Candida.*
        - Sugars not fermented.
            - Pellicle well developed, thick, on liquid media; no blastospores present. *Mycoderma.*
            - No pellicle, fragile ring occasionally; blastospores present. *Schizoblastosporion.*
- Colony creamy to viscous, smooth, shining, yellowish white, arthrospores rare or absent.
    - Gelatin liquefied.
        - Sugars fermented.
            - Pseudomycelium little branched, blastospore not in dense verticils.
                - No pellicle. *Parasaccharomyces.*
                - Pellicle produced. *Mycotorula.*
            - Pseudomycelium branched.
                - Pellicle very thin or none, blastospores in dense verticils. *Syringospora.*
                - Pellicle well developed, blastospores in terminal chains. *Monilia.*

- Gelatin not liquefied.
  - Sugars not fermented.
    - Pseudomycelium little branched. *Parendomyces.*
    - Pseudomycelium branched, colony dull, pellicle present. *Pseudomonilia.*
  - Sugars fermented.
    - Morphology unknown, no pellicle on liquid media. *Castellania.*
    - Blastospores pointed at one end, in dendroid clusters. *Blastodendrion.*
    - Blastospores spherical or ovoid, verticils compound elongate. *Mycotoruloides.*
    - Blastospores elongate-ellipsoid, verticils rudimentary, reduced to 2 spores each, colony folded. *Mycocandida.*

PROTEOMYCES

Proteomyces Moses & Vianna, Mem. Inst. Oswaldo Cruz **5**: 192, *Pls. 14-18, Fig. 2,* 1913.

The type species is *Proteomyces infestans* Moses & Vianna.

Yeast cells pyriform, germinating by germ tubes which become septate and produce thick-walled chlamydospores or arthrospores. These in turn germinate by highly developed hyphae; colonies cerebriform, vermiculate or furrowed, often appearing powdery in the center; pellicle formed on liquid media (rarely only a highly developed ring); no fermentation.

Isolated from abscesses and ulcers in man, the lesions are usually somewhat superficial but spread rapidly and widely. In the absence of sufficient morphologic data, I have assembled here those species with cerebriform or vermiculate colonies, showing no fermentation of sugar, whether gelatin is liquefied or not. It seems quite probable that further work will show that these species belong in *Zymonema* or in some closely related genus. Several of these species were referred to *Candida* (*Geotrichoides*) by Langeron & Talice (1932), but they seem better placed here until more is known of their morphology.

Key to Species

- Colony rose. *P. muris.*
- Colony rose (reddish orange on potato). *P. Brocianum.*
- Colony yellowish, becoming brown, remaining white on some media [see also *P. asteroides*].
  - Milk coagulated. *P. infestans.*
  - Milk not coagulated. *P. Brocquii.*
- Colony yellowish.
  - Glucose fermented, cells 4-8μ, chlamydospores terminal, 15-18μ. *P. cutaneum.*
  - Glucose and lactose fermented, chlamydospores up to 30μ. *P. Faverae.*
  - Sugars not fermented.
    - Cells 4-5μ in diameter, chlamydospores 8μ. *P. Balzeri.*
    - Cells 2-3 × 1, rarely up to 4μ, ellipsoid, chlamydospores rare. *P. Perieri.*
    - Cells 4-6μ, chlamydospores intercalary. *P. Griewanki.*
    - Cells 1.8 × 3.6μ, chlamydospores terminal. *P. cornealis*

Proteomyces muris (Ciferri & Redaelli) Dodge n. comb.

Mycotorula muris Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, **2**: 243-245, 280, 1925.

Isolated from spontaneous blastomycosis of a white rat.

Cells ovoid, guttulate, or ellipsoid, but often variously shaped, 4.5 × 5μ or 5 × 5μ up to 4.5 × 8μ, in malt extract forming a septate mycelium, 2-2.5 × 12.2μ. No ascospores.

Giant colonies in must gelatin round, verrucose, rose. No fermentation, no coagulation of milk.

The strain referred by Lodder (1934) to *Rhodotorula pallida* Lodder was evidently a contaminant.

Proteomyces brocianum (Pinoy) Dodge, n. comb.

Mycoderma brocianum Pinoy apud Anderson, Colas-Belcour & Broc, Arch. Inst. Pasteur Tunis **19**: 317-322, 1930.

Isolated from ulcerous lesions on the back of the hand. Not pathogenic to experimental animals.

Hyphae septate; arthrospores 4.5 × 3.5μ, thin-walled, no conidia.

Colonies on Sabouraud glucose agar at 37° C. creamy white with fine filamentous radiations on the surface with rose color visible on the fifth day and more marked the fourteenth day, becoming somewhat cerebriform in age.

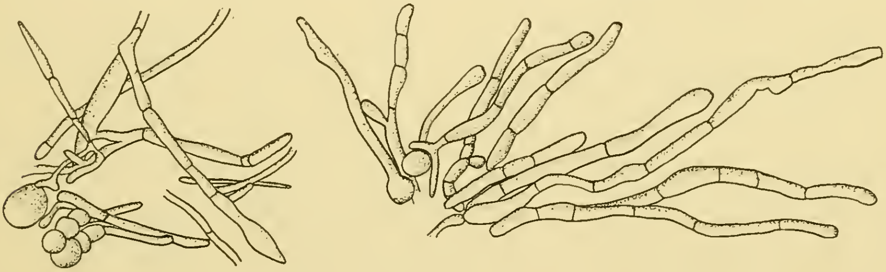

Fig. 41.—*Proteomyces infestans.* (After Moses & Vianna 1913.)

Colonies on gelatin similar. On potato, similar but reddish orange, only slightly folded at the center. On carrot, color remains rose. In potato decoction, sediment, no pellicle, liquid clear. Acid formation with maltose, sucrose, and glucose, none with lactose. Gelatin not liquefied.

Proteomyces infestans Moses & Vianna, Mem. Inst. Oswaldo Cruz **5**: 192, *Pls. 14-18, Fig. 2,* 1913.

Sporotrichum infestans ? Sartory, Champ. Parasit. Homme Anim. 655-656, 1922.

Mycoderma infestans Fonseca & Arêa Leão, Brasil Med. **43**: 667, 1929.

Isolated from hard, deep-seated abscesses on the extremities which become edematous, and the temperature rises to 39°-40° C. Pathogenic for guinea pigs and rats.

Mycelium septate, cells elongate, not easily separating into arthrospores. Blastospores pyriform, lateral, borne singly, chlamydospores terminal (Fig. 41).

Growth on Sabouraud maltose agar good, bright brown, cerebriform surface in 3-4 days, later the periphery with radial folds. On Sabouraud glucose, colony cream-colored, elevated, cerebriform. On Sabouraud conservation agar, colony smooth and flat with slightly dentate margin. On beet and potato, colony cream-colored with broad convolutions, quickly becoming white and powdery. In agar and Loeffler agar, colony cream-colored with a tough, wrinkled surface. In glycerol solution, both pellicle and sediment formed, the liquid remaining clear. On maltose broth, a thick pellicle with broad convolutions appears. Gelatin liquefied and milk coagulated. No indol. Survives exposure to a temperature of 80° C., for one-half hour but is killed after one hour at this temperature.

Proteomyces Brocquii (Beintema) Dodge, n. comb.

Parendomyces Brocquii Beintema, Ann. Derm. Syphiligr. VII, **4**: 399-423, *14 figs.*, 1933.

Geotrichum Brocqi Castellani & Jacono, Jour. Trop. Med. Hyg. **36**: 317-318, *Figs. 48-50*, 1933.

Isolated from the blood of a patient with papules and pustules forming extensive confluent ulcerated areas, originally described clinically as "pseudo-bromuride" by Brocq, Pautrier and Fernet. Probably the lungs were also involved, as this organism was regularly found in the sputum. Healed promptly on treatment with potassium iodide.

Cells cylindric, 10-15 × 4-5μ, hyphae little branched, forming arthrospores. Chlamydospores ovoid, fusiform or pyriform, walls thick, yellowish.

On Sabouraud agar, colony at first a viscous mass, then firmer, shining, reticulate wrinkled to vermiculate, at first white, then cream-colored, yellow, brown or chocolate. On Sabouraud conservation agar, growth very slow, colonies not over 3 cm. On potato, colony brown, soft. On carrot, growth better, lighter, drier, with more aerial mycelium. On serum, colonies white, flat, poor growth, no change in medium. On blood agar, growth slow. No growth on ascitic fluid. Growth slight with slight acidity on litmus milk. On peptone maltose broth and other liquids, no pellicle but the ring is highly developed. Sugars not fermented. Gelatin slowly liquefied after some time.

It is possible that this species is synonymous with the following which antedates it. However, *P. asteroides* has been so briefly described that I dislike to reduce *P. Brocquii* to synonymy without further study.

Proteomyces asteroides (Rischin) Dodge, n. comb.

Parendomyces asteroides Rischin, Arch. Derm. Syphilis **134**: 232-242, *9 figs.*, 1921.

Trichosporium asteroides Bolognesi & Chiurco, Micosi Chirurg. 597, 1927; Ota, Jap. Jour. Derm. Urol. **28**: [3], 1928.

Geotrichoides asteroides Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 68, 1932.

Lesions (probably contracted from a calf) appearing on beard and neck of man. Lesions infiltrated, elevated 1-1.5 mm., round or oval, confluent, swollen, soft, exuding brownish yellow secretion. Pathogenic to guinea pigs, rats, and mice.

Colony dull white, circular or oval, with sharp contours, becoming radially and spirally folded, turning yellowish and finally brownish. Growth best on sugar, potato, and gelatin media, poor on serum and ordinary agar. No fermentation. Yeast cells gram-positive (Fig. 42).

Near *P. Balzeri,* considered by Ota, Ann. Parasitol Hum. Comp. (1926) as close to *P. cutaneus*, later considered distinct.

Proteomyces cutaneus (Beurmann, Gougerot & Vaucher) Dodge, n. comb.

Oidium cutaneum Beurmann, Gougerot & Vaucher, Bull. Mém. Soc. Méd. Hôp. Paris **28**: 256-259, *Figs. 54-93*, 1909; Tribune Méd. **42**: 505, *Figs. 54-93*, 1909; Les mycoses nouvelles 52, *Fig. 4,* 1909.

Monilia cutanea Castellani & Chalmers, Man. Trop. Med. ed 2, 830, 1913.

Trichosporum cutaneum Ota, Ann. Parasitol. Hum. Comp. **4**: 2-13, 1926.

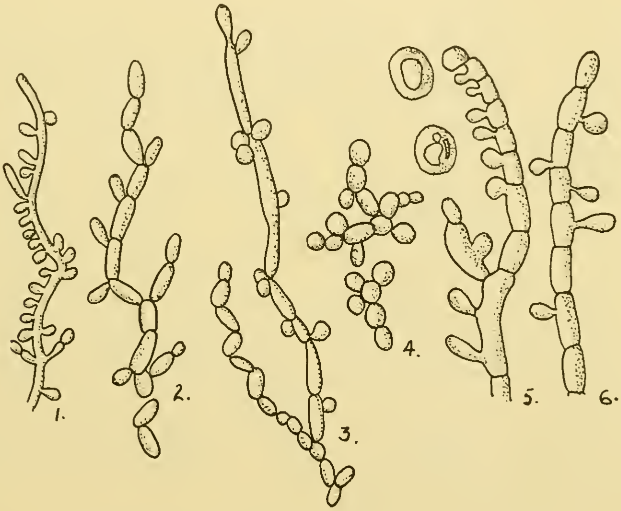

Fig. 42.—*Proteomyces asteroides.* (After Ota 1926.)

Mycoderma cutaneum Brumpt, Précis Parasitol. ed. 4, 1212, 1927.

Geotrichoides cutaneus Langeron & Talice, Ann. Parasitol Hum. Comp. **10**: 67, 1932.

Geotrichum cutaneum Almeida, Annaes Fac. Med. São Paulo **9**: 12, 1933.

Produced hypodermal and dermal gummatous infiltrations, later becoming ulcerated.

On glycerol agar are formed yeast cells, spherical or ovoid, 4-8μ, elongate forms 3-4 × 20μ, sometimes agglomerating. Cultures smooth, shining, viscous, growth good (Fig. 43).

On peptone glucose agar, these yeast cells give rise to pseudofilamentous cells 4-5 × 8-10μ and filamentous forms of cylindric cells with terminal chlamydospores 8-12μ in diameter. In a purely filamentous stage, cells are 2-4 × 20μ, conidiophores erect, simple or double, forming chains of cylindric spores 4 × 8μ. Chlamydospores terminal, 15-18μ. Colonies light yellow, reticulate, crumpled with aureole.

No trace of ascospores, even in old cultures.

Colonies on agar or potato light yellow, crumpled, mammillate, aureoled, powdery, and whitening in age. Yeast stage ferments glucose, filamentous stage does not.

In animal (pus, etc.), yeast form only appears. Repeated subcultures lose virulence.

Proteomyces Balzeri (Gougerot & Burnier) Dodge, n. comb.

Parendomyces Balzeri Gougerot & Burnier in Balzer, Gougerot & Burnier, Ann. Derm. Syphiligr. V, **3**: 282-295, *4 figs.,* 1912.

Saccharomyces Balzeri Castellani & Chalmers, Man. Trop. Med. ed 3, 982, 1919.

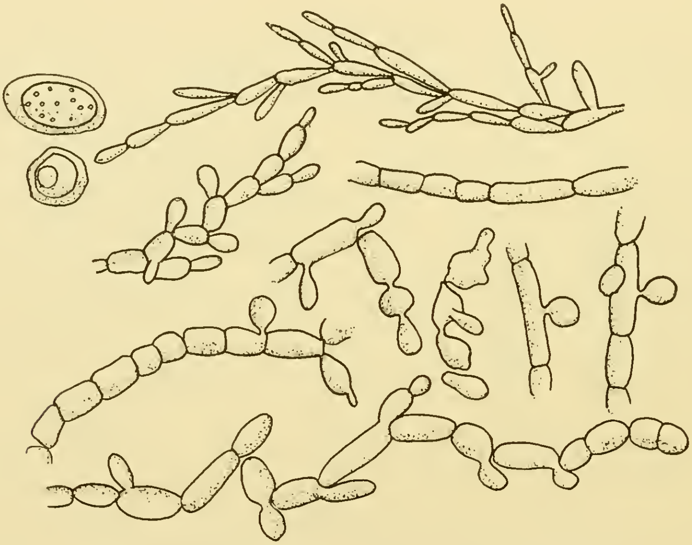

Fig. 43.—*Proteomyces cutaneus.* (After Ota 1926.)

Monilia Balzeri Brumpt, Précis Parasitol. ed. 3, 1922 (cited by Vuillemin, Champ. Parasit. Homme 86, 1931); Sartory, Champ. Parasit. Homme Anim. 708, 1923.

Trichosporum Balzeri Bolognesi & Chiurco, Micosi Chirurg. 597, 1927.

Trichosporon Balzeri Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Geotrichoides Balzeri Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 68, 1932.

Candida Balzeri Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Isolated from hypodermic gummata in crural region. Cured by medication with KI. Pathogenic to rabbit and guinea pig. Reported by Motta from mycosis of the pharynx.

Yeast cells spherical, 4-5(-6)μ in diameter, granular, vacuolate, thick-walled, reproduce by sprouting. Sprouting pseudomycelial forms 3 × 10-16μ. Hyphae in old cultures occasionally up to 3-4μ in diameter, cells mostly 2-2.5 × 14-28μ. Chlamydospores 8μ in diameter, yellowish. No asci found (Fig. 44).

On peptone glucose agar, growth whitish yellow, becoming more or less dark, elevated, cerebriform. Moist at first, then waxy and dull. Gelatin not liquefied; sugars not fermented [Ota].

Proteomyces Perieri (Matruchot & Antoine) Dodge, n. comb.

Oospora Perieri Matruchot & Antoine, Soc. Path. Comp. Nov. 13, 1917; Ann. Inst. Pasteur **32**: 202-214, 1918.

Monilia Perieri Castellani & Chalmers, Man. Trop. Med. ed. 3, 1092, 1919.

Trichosporon Perieri Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida Perieri Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Found in war wounds in France. Pathogenic to rabbit and guinea pig.

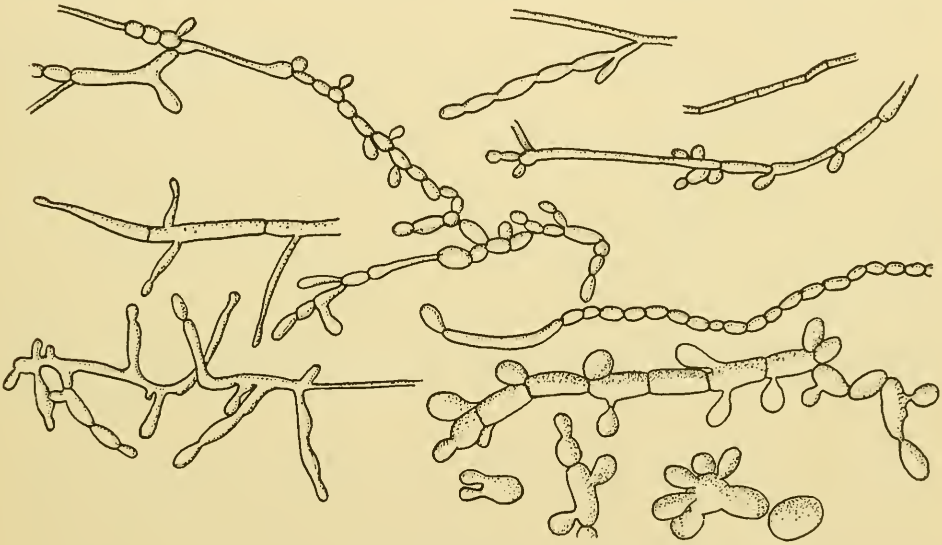

Fig. 44.—*Proteomyces Balzeri.* (After Ota 1926.)

On beet, pseudomycelial cells, elongate, 1-2 × 6-7μ, blastospores 2-3 × 1μ. On Sabouraud agar, yeast cells predominate, 1-2μ sometimes up to 4 or 5μ in diameter. Division either by sprouting or by equal fission. Oil droplets abundant in old cells. On vegetable decoctions with sugar, mycelial forms predominate. In the deposit are small white masses or spheres of mycelium which are sterile or show rare chlamydospores. On coagulated serum hyphae 1-3μ in diameter, blastospores 1-2μ. Optimum temperature for growth 15-18° C., but growth still good at 37° and slight at 45° C. Antiseptics rich in oxygen (e.g., $KMnO_4$, H_2O_2) do not check growth but produce gigantism (cells of double size).

On carrot, glycerol, beet, or gelatin at 16-18°, colonies begin as small, rounded excrescences with small crater, opaline. Later colonies confluent, folded, vermiculate, and finally cerebriform. On carrot it is dry or waxy.

Color seems to vary with medium, being yellow ochraceous on carrot, rose on beet, and whitish, turning ochraceous, on gelatin. On coagulated serum a thick white colony forms. In vegetable decoctions with sugar, a whitish pellicle and a white sediment form. Acid media less favorable than neutral or slightly alkaline. Gelatin not liquefied.

Proteomyces Griewanki (Neveu-Lemaire) Dodge, n. comb.

Mycoderma sp. (sensu Verdun) Griewanki & Laveau, Bull. Soc. Path. Exot. **12**: 478-482, 1919.

Mycoderma Griewanki Neveu-Lemaire, Précis Parasitol. 70, 1921.

First lesion appeared as tumor at base of big toe. In the course of five years extended dorsally and internally in foot, which finally became globose and like a bear's paw. Ulcerous, but was painful only on pressure, not sensitive to pricking. Finally the foot was amputated. A study of the tissues disclosed red grains.

Yeast cells 4-6μ in diameter, end to end, yellow brownish with numerous rounded, cocciform spores in chains or clusters. Filaments long, flexuous, septate, white, refractive, 2-2.5μ × 15μ, sometimes piled up, curved, or branched. Blastospores rounded, arranged in lines. Chlamydospores usually intercalary, rarely terminal. Arthrospores cut off squarely. Staining by Ziehl method good. By Gram method, walls stained, some cells staining deeply. Protoplasm granular, chlamydospores, arthrospores and budding elements rose. Some arranged in spirals and helices.

Cultivated on straw infusion (1.5% agar), on banana, potato + glycerol, and Sabouraud maltose agar, the latter one being unsuccessful. On the former in six days appear small cerebroid masses, gelatinous, yellowish, becoming size of small pea. Finally a rose-colored efflorescence over surface of media.

Proteomyces Faverae Dodge, n. sp.

Oidium sp. Favera, Giorn. Ital. Mal. Ven. Pelle **55**: 650-729, *10 pls.*, 1914.

On man produces cutaneous ulcers similar to those of *Z. dermatitidis*. Pathogenic to laboratory animals.

In 5-day-old cultures, the cells are spherical, 2-30μ in diameter, thick-walled, sprouting. Hyphae slender, straight or slightly curved, homogeneous, usually 1-2 sprouting from each sprout cell; septa not visible, terminal cell swollen. After 15 days, hyphae are septate, branched, unequal; yeast cells elongate in chains of 5-8 cells. Four-to-six-week-old cultures show only septate hyphae of long cylindric cells and chlamydospores; chains of ovoid spores 2-3 cells long on lateral branches.

Optimum growth at 34°-38° C., growth very slow at 18°-20° C. On Sabouraud glucose agar, colony is thick, yellowish, white, humid, creamy, margin festooned, surface irregular, rugose becoming cerebriform. After 2 weeks, shining white mycelium develops which rapidly covers the yeast colony and spreads beyond it, suggesting the pleomorphism of the Trichophytoneae. The colony becomes folded and furrowed with the bottom of the furrows moist and yollowish. On Sabouraud maltose, colony is similar, but with a slight rose tint. On common agar, thick, whitish, moist and rugose, mycelium very slow in appearing. Similar on glycerol agar, serum agar, and coagulated serum. On potato the colony is thick, moist, yellowish, tending to grayish, surface convoluted, margin elevated, mycelium appearing after a month. On beets, colony reddish but otherwise similar to that on potato. On gelatin, colony elevated, hemispheric, smooth, later becoming wrinkled. On beef serum, abundant whitish, floccose deposit. On glucose, maltose, or glycerol broth, white pellicle appears with floccose white sediment, liquid remains clear. Glucose and lactose slowly fermented; gelatin not liquefied; mik coagulated in 9-10 days.

Proteomyces cornealis (Nannizzi) Dodge, n. comb.

Monilia cornealis Nannizzi in Bencini & Federici, Atti R. Accad. Fisiocrit. Siena X, **3**: 748-766, *8 figs.*, 1928; *Ibid.* **4**: 92-94, 1929.

Isolated from corneal lesions. Pathogenic for experimental animals.

Cells 3.6 × 1.8μ or spherical 3.5-4μ in diameter; hyphae septate, cells 8μ × 2μ with chains terminal on lateral branches of blastospores. Hyphae of variable diameter 1.5-2.6μ, chlamydospores thick-walled, terminal.

On Pollacci agar, colonies irregular, margin erose, denticulate, smooth at first, later velvety, center folded and cerebriform vermiculate. On carrot agar, colony smooth, mammillate, folded, dirty white, moist, margin smooth. On Sabouraud agar, growth slow, irregular, small whitish colonies. On potato, colonies café-au-lait, diffuse, moist, plane then folded; on carrot, similar but yellowish. On coagulated egg albumen, colony yellowish white, medium partially liquefied; on coagulated serum, colony grayish, humid. On glucose broth, a slender ring and white sediment. Acid in glucose, sucrose, and salicin broths, slight acidity in fructose, lactose, mannite, dextrin, and galactose. Gelatin liquefied, milk and serum coagulated, methylene blue not reduced in glucose broth.

Proteomyces goensis Dodge n. sp.

Monilia sp. Froilano de Mello, Antiseptic **26**: 427-432, *2 pls.*, 1929; Bull. Soc. Path. Exot. **22**: 142-147, *2 figs.*, 1929.

Isolated in Nova Goa from multiple verrucose dermatitis with lesions suggesting those caused by *Zymonema dermatitidis.* Pathogenic to rabbits and white rats.

Cells up to 8μ in diameter, mycelium giving rise to groups of blastospores (or conidia).

On Sabouraud's maltose or glucose agar, colony whitish. On simple agar, and Gorodkova agar colony yellowish. On potato glycerol, colony dry, waxy, white. On broth, slight pellicle, turbidity, and white sediment. Milk coagulated and slowly digested. No fermentation of usual sugars, acid with maltose.

GEOTRICHUM

Geotrichum Link, Mag. Ges. Naturf. Freunde Berlin **3**: 17, 18, 1809.

The type species is *Geotrichum candidum* Link.

Colonies membranous, adherent to the substratum, dull, velvety due to abundant coremia, margins uneven, forming a pellicle on liquid media, gelatin liquefied, and sugars not fermented. Often a filament grows some distance from its colony and by repeated branching starts a new colony. Mycelium always growing by septation, never by sprouting; germination either unipolar or bipolar; the cells may become very long and even slightly branched before septation occurs. As the hypha matures the walls and septa become thickened, and the cells finally separate, forming arthrospores. Since thickening of the wall occurs before disarticulation, the spores remain strictly cylindric, the ends not round, while in some species the wall undergoes a gelification, and the arthrospores tend to become ellipsoid. In the latter case it is often difficult to separate species from *Monilia* (sensu strictiore) or *Candida* Berkh. excl. syn. Chlamydospores have also been reported (Fig. 45).

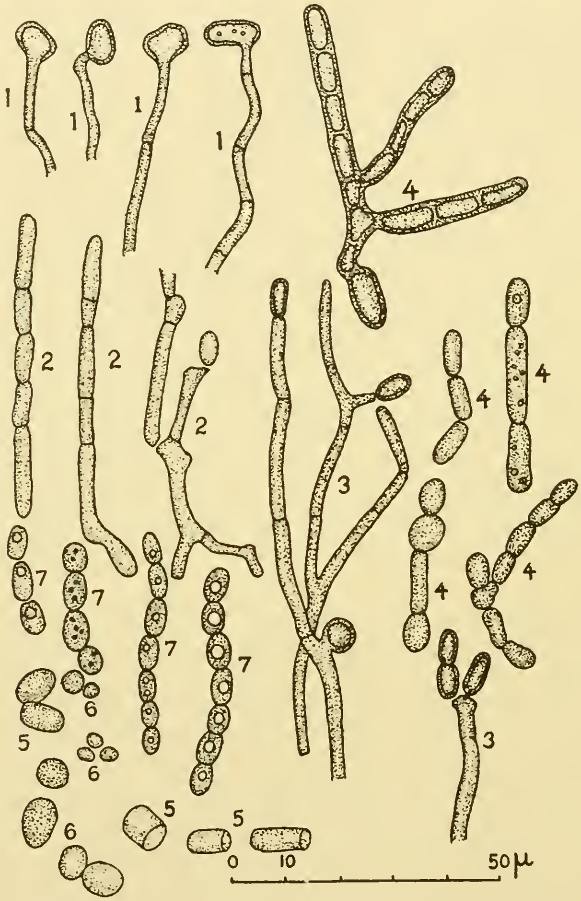

Fig. 45.—*Geotrichum*. *1*, germination of arthrospores; *2*, fragments of filaments; *3*, formation of arthrospores; *4*, chains of young arthrospores; *5*, young arthrospores showing cylindric appearance; *6*, mature arthrospores with rounded ends; *7*, chains of arthrospores. (After Langeron & Talice 1932.)

In *Geotrichum versiforme*, the only species whose cytology has been carefully investigated (Moore 1934), the young germ tube arising from the uninucleate arthrospore is 2-3-nucleate, rarely up to 8-nucleate. As the hypha elongates, septum formation proceeds rapidly until the resulting cells, eventually arthrospores, are uninucleate. In this process often the protoplasmic contents of certain cells disappear, perhaps aiding in the disintegration of the chains of arthrospores. Chlamydospores large and thick-walled spores are multinucleate. On certain media some blastospores are produced having 1-3-nuclei, often uninucleate. The so-called conidia of this species seem to be cells densely filled with a granular protoplasm and no trace of a nucleus. Obviously they are not conidia in the sense in which this term is usually used in other groups of fungi.

The genus is quite large, the species being mostly saprophytic on earth and decaying organic matter. Twelve have been reported on man, eight from infections of the respiratory tract, three from stools (parasitism unknown) and two from blastomycosis. *G. bostonense* differs in some respects from the other members of the genus and perhaps should be placed in a separate genus.

Key to Species

Colony red, milk coagulated.	*G. pulmonalis.*
Colony amber yellow to light yellow.	
Milk not coagulated.	
Acid in lactose.	*G. asteroides.*
No acid in lactose.	*G. famatum.*
Action on lactose not reported.	*G. rugosum.*
Milk coagulated.	*G. immite.*
Isolated from case of enteritis.	*G. rotundatum.*
Isolated from case of bronchitis.	*G. Muisa.*
Colony cream-buff to grayish white.	
No acid on sugars, hyphae 2-4μ.	*G. louisianoideum.*
Acid on fructose, maltose, and galactose.	*G. versiforme.*
Colony greenish.	*G. bostonense.*

Geotrichum pulmoneum (Bennett) Basgal, Contr. Estudo Blastomycoses pulmonares 49, 1931; Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 74, 1932.

Oidium pulmoneum Bennett, Trans. R. Soc. Edinburgh **15**: 2:277-294, 1842.

Oospora pulmonea Saccardo, Syll. Fung. **4**: 16, 1886.

Mycoderma pulmoneum Vuillemin, 1891; Brumpt, Précis Parasitol. ed. 4, 1214, 1927.

Monilia pulmonea Castellani & Chalmers, Man. Trop. Med. ed. 2, 829-830, 1913.

Found in sputum at autopsy of case of pseudotuberculosis.

Hyphae septate, dichotomous, 5-10μ in diameter, spores ovoid, smooth, 10-14μ, borne in chains [Robin's (1853) figures almost suggest *Scopulariopsis*].

Geotrichum pulmonale (Ciferri & Redaelli) Dodge, n. comb.

Mycotorula pulmonalis Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, **2**: 205-212, 281-282, 1925.

Rhodotorula mucilaginosa var. *sanguinea* Lodder, Anaskosporogenen Hefen **1**: 98-99, 1934.

Isolated from sputum of a case of pulmonary abcesses. Pathogenic for guinea pigs and rats.

Cells rounded, slightly ovoid, often cylindric and catenulate, forming mycelium, hyaline or guttulate, 3-4μ in diameter or 2 × 5-11μ. No ascospores.

Colonies on carrot agar, shining, peach-blossom red, finally cinnabar red, pellucid, slightly verrucose with smooth margin which finally becomes sinuous. On malt agar, colonies red with a suggestion of orange, moist, smooth, slimy. On gelatin, colony small, thick, smooth with ragged margin, red. On malt extract, floating islets and carmine red ring, with thick rose to red sediment and turbid liquid. No fermentation, milk curdled, gelatin slowly liquefying after 100 days.

The relationship of this species is not altogether clear. It seems to be rather aberrant in *Geotrichum* and perhaps belongs in *Torulopsis,* but according to descriptions, it has too much mycelium for that genus. Unfortunately, Lodder did not choose her media to encourage the formation of mycelium, and she examined her cultures altogether too soon to observe it if it did occur.

Geotrichum asteroides (Castellani) Basgal, Contr. Estudo Blastomycoses Pulmonares. 48, 1931.

Monilia asteroides Castellani, Jour. Trop. Med. Hyg. **17**: 307-309, *1 fig.,* 1914.

Oidium asteroides Castellani & Chalmers, Man. Trop. Med. ed. 3, 1095, 1919.

Mycoderma asteroides Brumpt, Précis Parasitol. ed. 4, 1212, 1927.

Isolated from stools in cases of pseudosprue, also reported from cases of chronic bronchitis.

Colonies on glucose agar have characteristic vermiculate, more or less radiating appearance. Yellowish white to amber. Organism does not clot milk, grows badly or not at all on coagulated serum which is not liquefied. Gelatin liquefied very slowly. No fermentation of sugars; acid on glucose, fructose, maltose, sucrose, galactose, and lactose. Castellani & Chalmers (1919) state that it produces acid and clots in litmus milk.

Geotrichum famatum (Harrison) Dodge, n. comb.

Mycotorula famata Harrison, Trans. R. Soc. Canada, Biol. Sci. **22**: 216-217, 1928.

Isolated from a wound in the hand by Dr. Rasch (No. 1136 London Collection).

From young malt extract and malt agar cultures cells are spherical, ellipsoid and cylindric with abrupt ends and rounded corners, sprouting from ends and sides, with groups of 5-6 cells resulting. Spherical cells 1.7-3.5μ in diameter, ellipsoid 3.5 × 2.0μ in diameter. In malt extract, cells are somewhat larger, attaining 4.2 × 3.8μ, cylindric cells, 4.5 × 1.7μ. From 145-day-old cultures cells ellipsoid or cylindric with short hyphae, occasional large cells 6.6 × 5.0μ, occasional oil droplets. Good growth between 25° and 37° C.

On malt agar, growth white, shiny, slightly raised, spreading. On B.P.B. agar, growth similar but pale blue. On potato, growth is pure white, slightly waxy, and spreading. On malt gelatin surface growth is white, slightly raised and shining, gradually sinking into gelatin, forming a funnel-shaped depression. Giant colony on malt gelatin round, shiny with raised margin showing concentric ring halfway from center to edge, slight radiate markings. In malt extract, there is formed a thin film and ring with flocculent turbidity in the liquid and heavy sediment. Very slight growth under olive oil. No fermentation of any sugar. Acid with ring formation and turbidity, clearing about the tenth day, in glucose, mannose, galactose, fructose, and sucrose (no ring in glucose). In other sugars growth similar, but no acidity and no ring formation in glycerol and inulin. Sucrose inverted. Milk not coagulated, slight alkalinity in 115 days. Gelatin slightly liquefied in 29 days, completely in 116 days.

Geotrichum rugosum (Castellani) Dodge, n. comb.

Endomyces rugosus Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia rugosa Castellani & Chalmers, Man. Trop. Med. ed. 2, 827, *Fig. 414,* 1913.

Hemispora rugosa Castellani & Chalmers, Man. Trop. Med. ed. 3, 1108, 1919.

Parendomyces rugosus Ota, Derm. Woch. **78**: 236, 1924.

Trichosporum rugosum Ota, Jap. Jour. Derm. Urol **28**: [4], 1928.

Originally isolated from cases of bronchitis and tonsillitis in Ceylon. ?Isolated from cases of thrush by Pijper (1917) in South Africa.

Colony yellowish amber, or brownish, surface crinkled, almost vermiculate. No fermentation, slight acid produced on glucose, fructose, maltose, and galactose. Castellani states no action on milk, gelatin slowly liquefied. Pijper states that gelatin and serum were not liquefied by his strain, milk rendered acid, and slightly clotted and peptonized. It is possible that Pijper's organism was *Mycoderma pararugosum* instead of this species.

Geotrichum immite (Castellani) Agostini, Jour. Trop. Med. Hyg. **35**: 266-269, *3 figs.,* 1932.

Blastomycoides immitis Castellani, Amer. Med. **23**: 290-291, 1928; Amer. Jour. Trop. Med. **8**: 385, 386, 1928.

Isolated by Castellani from a case of "blastomycosis," authentic cultures studied and described by Agostini.

Mycelium slender, hyaline, 2-2.5μ in diameter, not branching, often uniting in fascicles, later mycelium thicker, 3-5μ, with cylindric arthrospores 6-9μ, racquet mycelium present. Large chlamydospores rich in fat globules, present.

Colonies on Pollacci agar, white, fluffy, powdery, adherent to the surface, becoming slightly yellowish brown. Growth similar on carrot and potato. On mannitol agar, colonies dark brown to black with pigment diffusing into the medium. Glucose and maltose not fermented, milk not coagulated. No growth on blood agar. Gelatin and serum rapidly liquefied. Optimum temperature 22°-27° C.

From the description of the organism given by Agostini, it is quite evident that this organism is not related to *Coccidioides immitis* and that the synonymy quoted by her is incorrect. While Castellani does not state, it is probable that the organism was isolated in Louisiana, perhaps the atypical case mentioned by Castellani (1933, p. 297), while *Coccidioides* is practically confined to California, most of the patients elsewhere giving a history of a recent sojourn in that state. It is also quite probable that Agostini is wholly unfamiliar with the references she quotes, or she would not suggest that the ascospores reported by American workers in *Coccidioides* are oil globules.

Geotrichum rotundatum (Castellani) Almeida, Annaes Fac. Med. São Paulo **9**: 12, 1933.

Endomyces rotundatus Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912; Arch. de Parasitol. **16**: 184-186, 1913.

Monilia rotunda Castellani & Chalmers, Man. Trop. Med. ed. 2, 828, 1913.

Monilia rotundata Castellani, Jour. Trop. Med. Hyg. **17**: 307, 1914.

Oidium rotundatum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1095, 1919.

Mycoderma rotundatum Brumpt, Précis Parasitol. ed. 4, 1213, 1927.

Myceloblastanon rotundatum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida rotundata Basgal, Contr. Estudo Blastomycoses Pulmonares 49, 1931.

Isolated from saliva and stools from cases of sprue and enteritis.

Growth on glucose agar wrinkled and yellowish. Acid formation with glucose, fructose, maltose, galactose, and lactose. Milk strongly acidified and coagulated. Coagulated serum not liquefied. Gelatin liquefied, sometimes slowly.

Geotrichum Muisa (Mattlet) Dodge, n. comb.

Torula Muisa Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 25, 26, 1926.

Patient a chief in the Belgian Congo who had a bronchitis of long standing. Mucous sputum containing well-defined, greenish purulent islets which on examination showed cells of above organism. Medication with potassium iodide and sodium cacodylate caused amelioration of symptoms. Patient disappeared.

In sputum, spherical cells, 4-5μ in diameter, with clear double membrane, uniformly colored content with some large refringent granules. No sprouting forms. Optimum temperature for growth 37° C.

In potato decoction after three days at 37°, only hyphal forms. Branched hyphae of variable diameter, 1.5-3.5μ, septa distant, chlamdospores spherical, 3-7μ in diameter.

On Sabouraud agar at 37° C., colony amber yellow, coherent, with dull surface; later wrinkled and furrowed, with abundant submerged hyphae. In potato decoction, it forms a voluminous sediment of yellowish flakes, no pellicle. No fermentation of sugars. Coagulation and acid formation with milk. Gelatin liquefied.

Geotrichum louisianoideum Castellani, Med. Press Circular **136**: 439, 1933; Jour. Trop. Med. Hyg. **36**: 304, 1933.

Isolated from cases of primary pulmonary blastomycosis, one case from Louisiana, two subsequent cases from Southern Italy.

Hyphae undulating, 2-4μ in diameter, arthrospores abundant and very short; chlamydospores also produced. Asci [?] in tissues of experimental animals.

On glucose agar, colony fluffy, white or grayish white. No pigmentation on mannitol agar. No fermentation or acidity on any carbohydrate. Milk neither coagulated nor digested, but may become alkaline. Gelatin and serum liquefied rapidly.

Geotrichum versiforme Moore, Ann. Missouri Bot. Gard. **21**: 349-366, *1 pl.* 1934.

Isolated from thick, greenish, mucopurulent, at times bloody tenacious sputum from a patient with bronchiectasis and pulmonary infiltration of several years' duration.

Organism varies in size and proportion on various standard media, attaining the largest cells on malt extract agar. Hyphae 3-8μ in diameter with young cells approximately 6-40μ long; arthrospores with abrupt or rounded ends 4-9 × 6-18μ; round, thick-walled chlamydospores 4-18μ in diameter and elongated, 6-8 × 20-30μ; small round cells 4-6μ in diameter, possibly blastospores; conidium-like cells, round 4-6μ in diameter, pyriform 3-4 × 4-6μ. On malt extract agar, cells spherical approximately 15μ in diameter; arthrospores 6-9 × 12-18μ, also barrel-shaped cells and smaller spherical cells. Old cultures show many arthrospores and fewer hyphae (Fig. 46).

Colonies vary from dull grayish white, on Raulin's, Richard's, and Czapek's agar, becoming light cream with age, to a dull cream to creamy-buff on Sabouraud's, nutrient, glycerol, and lactose agar. On potato-dextrose, growth grayish white to light cream, showing a plushlike whirl. Colony on malt extract vermiculate or pebbled. Sabouraud colony velvety, while cultures on nutrient, lactose, and Endo's agar moist. Mycelium partially submerged in Richard's, Czapek's and oatmeal agar. In broth, pellicle and a fairly heavy sediment. No fermentation of sugars. Acid on maltose, galactose, d-mannose, l-xylose, and fructose. No acid on lactose, sucrose, glucose, raffinose, l-arabinose, rhamnose, and inulin. Milk slowly acidified and coagulated. Plain gelatin liquefied on surface after 12 days, beef-extract gelatin after 14 days.

It seems probable that the following unnamed organism may belong here.

Oospora sp. Bachmann, Centralbl. Bakt. I, **86**: 129-132, 1921.

This species is nearest to *O. lactis* of Rabenhorst, Kryptogfl. Deutschl. ed. 2. Metachromatic granules lacking near vacuoles. Oidia 7-10μ in diameter, not multinucleate.

Cultures, on maltose agar, gray white with seedlike surface. After 3 days, colony becomes yeastlike near periphery, margin showing mycelium, with cylindric or ovoid cells, 5-7μ long, occasionally chlamydospores up to 10μ with highly refractive wall. Longer filaments in young agar colonies. On gelatin plates, colonies as above, except that no filaments appear in 4-6 days. Mycelium 2μ thick. Fermentation slight except with maltose. Malt gelatin is liquefied.

Geotrichum membranogenes (Martins) Dodge, n. comb.

Zymonema pulmonalis membranogenes Martins, C. R. Soc. Biol. **98**: 1162-1164, 1928.

Isolated from a case of ill-defined pneumonopathy, frequent and abundant hemoptyses, temperature oscillating between 37° and 39° C. Portugal. Not markedly pathogenic for laboratory animals.

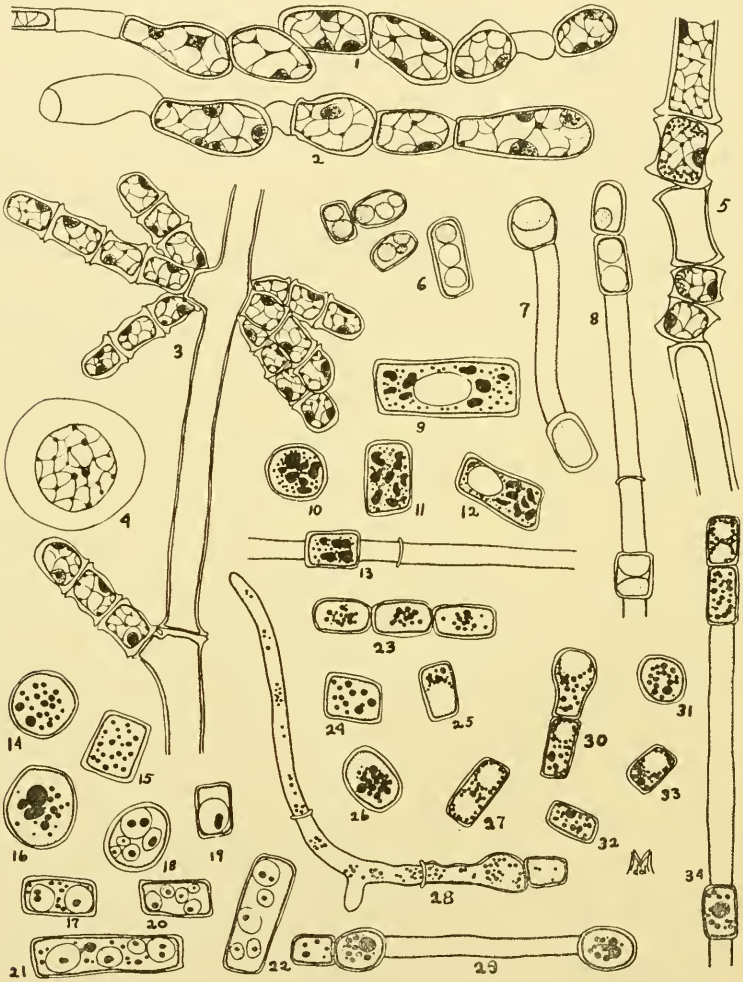

Fig. 46.—*Geotrichum versiforme.* *1, 2, 4,* coenocytic cells, probably chlamydospores, on Sabouraud agar; *3,* submersed mycelium showing branching, in Sabouraud agar; *5,* aerial mycelium on same medium; *6-8,* cells stained to show volutin; *9-13,* cells showing glycogen as dark heavily stained material, lipoids as small hyaline granules, and small dark chondriosomes; *14-22,* cells showing volutin granules in the vacuoles; *23-34,* living cells stained to show fat content. (After Moore 1935.)

Mycelium present, septate, forming arthrospores and terminal chlamydospores. Growth at room temperature, but optimum at 37° C.

On Sabouraud glucose and maltose agar, growth in 24 hours, colony covering the medium and climbing the tubes, yellowish white, tough, easily separating from the medium, surface moist and finely mottled. On carrot, the same, except slight velvet on surface of colony. No spores on Gorodkova agar. On gelatin, growth slow, with liquefaction of medium. No development on several other media tried.

Geotrichum bostonense Dodge, n. sp.

Parasaccharomyces G Nye, Zerfas & Cornwell, Amer. Jour. Med. Sci. **175**: 163-164, 1928.

Isolated from stools in case of carcinoma of stomach.

Cells ovoid, 4-5μ in diameter, few elongate forms and many septate hyphae. Cytoplasm slightly granular and contains vacuoles without refractive granules. No nucleated cells.

On agar, colonies elevated, regular, shiny, and dirty green in color. In peptone water, growth at bottom of tube, with clear supernatant liquid and no pellicle. In gelatin stab marked mycelial production, but no lateral outgrowths. Acid, without fermentation, with all sugars except sucrose and lactose. Gelatin liquefied.

MYCODERMA

Mycoderma Persoon, Myc. Europaea 96, 1822.

The type species is *Mycoderma mesentericum* Pers.

Morphology, in general, as in *Geotrichum* but gelification of the walls more complete, so that in old cultures spherical or ellipsoid cells are abundant; cells contain abundant oil globules and grow rapidly, soon covering liquid media with a thick folded pellicle with radial folds running to within about 2 mm. of the periphery; giant colonies sometimes yellowish, surface dull; gelatin not liquefied, sugars not fermented.

While the majority of species in this genus are saprophytic, some species have been found on man, mostly confined to the respiratory and digestive tract, in the latter merely isolated from stools and not known to be etiologic agents of disease. A few species have been described as producing abscesses in the skin, all but one so poorly described that the reference here is not certain. The one well-described species, *Mycoderma nobile,* differs from all the other members of the genus in the presence of raquet mycelium and in fermenting sugars, and perhaps belongs in another genus. When its perfect stage is found, quite likely it will appear to belong to *Zymonema.*

Key to Species

Sugars fermented.
    Glucose and starch fermented, colony white, raquet mycelium present. *M. nobile.*
    Glucose, sucrose, and lactose fermented, colony becoming sulphur yellow, no raquet mycelium present. *M. sulfureum.*
Sugars not fermented.
    Colony white.
        Colony zonate velvety. *M. Nyabisi.*
        Colony with elevated wrinkled yellowish center. *M. virulens.*

Colony yellowish.
Colony elevated granular, yellow. *M. Caoi.*
Colony wrinkled, yellowish amber, or brownish. *M. pararugosum.*
Colony zonate.
Arthrospores nearly all spherical. *M. Muyaga.*
Arthrospores strictly cylindric, not abundant. *M. Kieta.*
Arthrospores elongate ellipsoid [cylindric with rounded ends]. *M. Issavi.*

Mycoderma Nyabisi Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 30, 31, 1926.

Geotrichum Nyabisi Basgal, Contr. Estudo Blastomycoses Pulmonares 49, 1931.

Isolated in Belgian Congo from a case of chronic bronchitis, showing regular presence of cylindric cells, 3-5 × 6-8μ.

In potato decoction, close to *Mycoderma Kieta* but arthrospores rare, elongate, 1.5-2μ, chlamydospores barrel-shaped, 8 × 5μ.

On Sabouraud agar at 37° C., colony is white, velvety, with concentric zones of alternating long and short velvet. At 25° C. the velvet is thicker and the zones are less marked. The zone of propagation is moist, as in *M. Issavi.* Filaments abundant in the medium. Gelatin stab, surface white velvety, margin evenly indented. Acid formation on the second day with glucose, fructose, galactose, slight with inulin, solutions becoming alkaline on nearly all media on the 20th day, at least in the upper layer of the liquid. More strongly acid at the bottom of the tube in glucose, fructose, galactose. Inulin more strongly acid both at the bottom and immediately under the pellicle. No sugars fermented. Litmus milk turns slightly acid, but does not coagulate. Gelatin not liquefied.

Mycoderma ? virulens (Norris) Dodge, n. comb.

Saccharomycete pleomorphus virulens Norris, Southern Med. Jour. **24**: 482-489, *16 figs.*, 1931.

Isolated from sputum in a case of bronchomoniliasis. Toxins produced, causing anemia, leucopenia, and neutrophilic depression in experimental animals.

Cells spherical to ovoid, 2-10μ, hyphae up to 50μ in length. Cells usually uninucleate, though ovoid ones sometimes have 4 nuclei in old cultures. Hyphae composed of clavate cells, with large terminal cells. No true lateral conidia. Arthrospores present, blastospores in clusters. Sprout cells divide by amitosis, hyphal cells by karyokinesis.

Organism killed after 15 minutes at 58° C. Direct sunlight killed in two hours, inhibited growth in one hour. "Ultraviolet light not harmful." Killed by metaphen 1:64,000; iodine, 7% solution in 1:120 dilution; half saturated KI; gentian violet 1:25,600.

Colony white, center elevated, wrinkled, slightly yellow; margin white, very irregular and feathery. Growth on glucose agar white with yellow brown pigment on exposure to ultraviolet light. Yellow pigment on lead agar. On potato, growth slow, confluent, smooth, fine, white, not elevated. On Kracke & Teasley broth, a heavy, tenacious wrinkled pellicle forms, with heavy chalky sediment. Alkali formed on Endo's medium. Granular soapy pellicle on arabinose. No fermentation of sugars but slight acid formation with maltose, rhamnose, arabinose. No action on inulin, lactose, and mannite. Milk not coagulated and no acid formed. Gelatin not liquefied.

Mycoderma Caoi Jannin, Les Mycoderma 186-187, 1913.

Monilia Caoi Castellani & Chalmers, Man. Trop. Med. ed. 2, 831, 1913.

Geotrichum Caoi Basgal, Contr. Estudo Blastomycoses Pulmonares 49, 1913.

Oidium 22 Cao, Zeitschr. Hyg. **34**: 317-318, 1900.

Isolated from a case of chronic bronchitis in an old man. Pathogenic to rabbits.

Cells large, hyphae long and little branched.

Colonies on agar yellowish, granular, elevated with radial strands at margin. On potato, growth abundant with irregular margins, granular, yellow with surface of potato browned. Star-shaped colonies on gelatin surface, inverted fir tree growth along the stab. No fermentation of sugars. No change in milk.

Mycoderma pararugosum (Castellani & Douglas) Dodge, n. comb.

Hemispora pararugosa Castellani & Douglas, Jour. Trop. Med. Hyg. **24**: 149, *pl. 1,* 1921.

Isolated from sputum, no fever, cough with mucopurulent expectoration, with no blood in mild type of cases. In severe type, cases resemble phthisis, patient emaciated, hectic fever with blood in expectoration; often developing after severe tonsillitis, with yellowish gray patches. Physical examination revealed patches of dullness, fine crepitation, and pleural rubbing.

No fermentation or acidity with sugars, no action on milk, gelatin not liquefied.

It is quite possible that the organism described by Pijper (1917) from South Africa under the name *Monilia rugosa* (p. 219) should be referred here, although it differs in minor characters.

Mycoderma Muyaga Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 28-29, 1926.

Isolated in cases presenting symptoms of true dysentery and enteritis in natives of Belgian Congo. No amebas or cysts present. Medication with intramuscular injections of emetine and administration of mild laxatives gave amelioration of symptoms.

In potato decoction, hyphae septate, branched, 2.5-7μ, narrowed at the septa. The young, slender hyphae are rich in protoplasm and contain few fat droplets, few or no septa. Secondary hyphae arise near, but not at, transverse walls. In older hyphae the positions of rupture are forecast by the condensation of protoplasm about the fat droplets without thickening of membrane. Arthrospores nearly spherical, not thick-walled. Optimum temperature 22°-25° C.

On Sabouraud agar at 37°, colony creamy yellow, margin of radiating hyphae, adherent to the medium with radial folds. At 25°, colony covered by a short, thin, tufted velvet, white with concentric zones. On gelatin stab, surface colony white, velvety, with fine radiations. In potato decoction, dense deposit of yellowish, filamentous flakes. Liquid turbid, of mucus consistency. Acid production with glucose, fructose, and galactose before pellicle formation. When pellicle covers the surface, alkali production starts, but ceases when the pellicle is immersed. With maltose, sucrose, lactose, mannite, dextrin, and inulin, the trend is definitely alkaline. No fermentation. Milk turned slightly acid, no coagulation. No liquefaction of gelatin.

Mycoderma Kieta Mattlet, Ann. Soc. Belge Méd. Trop. 6: 29-30, 1926.

One of the fungi isolated from a case showing symptoms of enteritis in Belgian Congo. Treatment with mild laxatives and intramuscular emetine caused amelioration of symptoms.

In potato decoction after 3 days, hyphae branched, 2.5-7μ in diameter, narrowed at the septa. The young, slender hyphae are rich in protoplasm and contain few fat droplets, few or no septa, and abjoint the arthrospores. Secondary hyhpae arise near, but not at, the septa. The older filaments form series of three or four chlamydospores each, square or slightly oblong. After 30 days there still remains a large quantity of mycelium. Optimum temperature for growth 22°-25° C.

On Sabouraud agar at 37°, colony dull, yellow cream, with concentric zones. At 25°, colony yellow, powdery; later the center becomes humid and zones, alternately dull and dusty, are formed. On gelatin stab, colony at surface white, velvety, mammillate at center, with fine rays toward the margin. In potato decoction, sediment white coalescent tufts, the liquid remaining clear. Slight acid formation at first with glucose, fructose, and galactose. After the pellicle forms, the upper portion becomes alkaline, but alkali formation ceases when the pellicle is immersed. No action on lactose and inulin. Maltose, sucrose, mannite, and dextrin become slightly alkaline. Milk slightly acidified, not coagulated. Gelatin not liquefied.

Mycoderma Issavi Mattlet, Ann. Soc. Belge Méd. Trop. 6: 26-28, 1926.

Isolated from cases presenting symptoms of true dysentery and enteritis in natives of Belgian Congo. No amebas or cysts present. Medication with intramuscular injections of emetine and administration of mild laxatives gave amelioration of symptoms.

In potato decoction after 3 days at 25° C., well-developed hyphae, branched, 2.5-7μ, narrowed at septa. The young, slender hyphae are rich in protoplasm and contain few fat droplets, few or no septa. Secondary hyphae arise near, but not at, the septa. Arthrospores cylindric when first abjointed, ends rounding later. Short, spherical arthrospores rare. After 30 days most of the hyphae are changed into arthrospores. Spores of variable volume as hyphae of all sizes segment. The greatest measure 30 × 7μ. No yeast forms seen. Optimum temperature for growth 22°-25° C.

On Sabouraud agar at 37°, colony cream yellow, humid, margin of radiating hyphae, strongly adherent to medium, later little elevations at center.

When growth reaches edge of tube, hyphae push up along the glass. Below, abundant development of hyphae. At 25° on same medium, colony covered by short white velvet which forms concentric zones of different thicknesses with wrinkled center and humid zone of growth. On gelatin, velvety, white growth at surface with large rays from center toward edge. In potato decoction, dense deposit of yellowish, filamentous flakes. Liquid turbid and of mucus consistency. Acid production with fructose, and galactose before pellicle develops. With pellicle on surface, upper portion of liquid becomes alkaline but alkali production ceases if pellicle is immersed. No action on glucose. In sucrose and lactose slight acid formation at first but giving place to alkali by twentieth day. Trend strictly alkaline with maltose, mannite, dextrin, inulin. No fermentation. Slight acidification of milk but no coagulation. Gelatin not liquefied.

Doubtful Position

The following species are referred here either on account of the lack of adequate descriptions or because of characters which make their presence in this genus anomalous.

Mycoderma nobile A. Sartory, R. Sartory, Meyer & Charles, Ann. Myc. **29**: 325-338, *6 figs.*, 1931.

Following a wound, organism produces a soft tumor suggesting a gumma on the forearm, with vertebral metastasis. Besides the *Mycoderma,* cultures on alkaline media showed colonies of *Staphylococcus citreus,* especially in coagulated serum. Pathogenic for guinea pigs.

Cells in the tissue spherical, 5μ in diameter, or ovoid, 3.5 × 7μ, no mycelium observed. On carrot, long tufts of hyphae, up to 5μ in diameter, branches long and slender, 1-2μ in diameter. Raquet mycelium present. Sometimes the branches are strongly curved, sometimes chlamydospores and arthrospores are formed.

On agar and gelatin media growth velvety at first, finally becoming powdery or chalky or even moist, adherent, and viscous. On glucose media there is a blackening of the medium. On glycerol agar growth luxuriant, zonate, of glabrous and silky zones. On carrot, colonies whitish velvety, covering the medium. Growth similar on potato but a little slower. Growth only at 37° C., not at room temperature, ceasing at about the twelfth day. In liquid media tough pellicle, folded, forms a ring, falls to bottom after 15-20 days, and a new pellicle is formed. Acid and fermentation of glucose and starch. Acid with sucrose and lactose, slight fermentation with galactose and mannose, no action or assimilation of fructose or maltose. Milk coagulated and digested. Gelatin not liquefied.

Mycoderma sulfureum (Beauverie & Lesieur) Dodge, n. comb.

Cryptococcus sulfureus Beauverie & Lesieur, Jour. Physiol. Path. Gén. **14**: 996-998, 1912.

Monilia sulphurea Vuillemin, Champ. Parasit. Homme 84, 1931, non Persoon.

Isolated from exudate of pharynx of a woman suffering from a severe case of typhoid fever. Inoculations negative.

On carrot, after 5 days at 25° C., cells spherical, occasionally slightly oblong, 2-8μ in diameter. In malt extract (40 days) mycelium branched, septate, 1-4μ in diameter, often terminating in a swollen budding head. No spores seen on plaster block. In Raulin's liquid at 26° after 6 days, cells 2.5-5.5μ; after 36 days, cells 2-4.5μ in sediment. Grows at 25° and 37° C.

On potato, growth good, margin with round denticulations, dirty white, becoming sulphur yellow, the upper portions of colony remaining dirty white and pulverulent. On malt gelatin, colony much wrinkled and prominent. In malt extract after 40 days, appear floccose masses of mycelium floating and immersed. In carrot juice, sediment in 17 hours. In Raulin's liquid, after 53 hours, ring several centimeters high. In malt extract, a very small ring in 23 hours and pellicle over surface in 73 hours. Glucose, sucrose, and lactose fermented. Maltose not fermented. Gelatin not liquefied.

Mycoderma multifermentans (Castellani) Dodge, n. comb.

Geotrichum multifermentans Castellani, Med. Press Circular **136**: 439, 1933; Jour. Trop. Med. Hyg. **36**: 303, 304, 1933.

Isolated from a case of "blastomycosis."

Hyphae 2-4μ in diameter, arthrospores and chlamydospores present.

On glucose agar, growth fluffy, white, grayish white, or grayish brown. No pigmentation of medium on mannitol agar. No fermentation, acid produced on glucose, fructose, galactose, maltose, lactose, mannitol, glycerol, inulin, rhamnose, inositol, arabinose, xylose, and dextrin, and after 21 days in all the carbohydrates tried. Litmus milk alkaline, gelatin and serum not liquefied.

Mycoderma subtile (Blanchard) Verdun, Précis Parasitol., 1912; Jannin, Les Mycoderma, 232-235, 1913.

Oidium subtile-cutis Babes, Termeszettuduomanyi Közlöny **14**: 192-195, 1882; Biol. Centralbl. **2**: 569-571, 1882 [DeBoyer & D'Antin, Prog. Méd. **9**: 1025, 1881].

Oidium subtile R. Blanchard, in Bouchard, Traité Path. Gén. **2**: 839, 6, 1895.

Endomyces subtilis Castellani & Chalmers, Man. Trop. Med. ed. 1, 601, 1910.

Monilia subtilis Castellani & Chalmers, Man. Trop. Med. ed. 2, 829, 1913.

Parasaccharomyces subtilis Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 273, 278, 1918.

Geotrichum subtile Almeida, Annaes Fac. Med. São Paulo **9**: 12, 1933.

Isolated from abscess on thigh and on abdomen. Round ulcers the size of a pea up to four times as large and going even deeper than the corium. Borders sharp, surrounded by a mulberry-red zone. Ulcer covered with crust 2-7 mm. thick. Radulescu & Babes inoculated rabbits subcutaneously. Typical ulcerations of disease developed in 3-5 days and were transmitted to other animals. Fungus recovered.

Hyphae straight at the surface of cultures, parallel, dichotomous, partly homogeneous, partly septate, 6μ in diameter. In the middle third the hyphae turn outward, so that they end at the surface. Arthrospores ovoid, cylindric or elongate, ellipsoid, even biscuit-formed, abjointed from ends. No asci or chlamydospores.

Mycoderma pseudoalbicans (Neveu-Lemaire) Dodge, n. comb.

Monilia pseudoalbicans Neveu-Lemaire, Précis Parasitol. Hum. 77, 1921.

Monilia albicans Magrou, Montpellier Méd. **39**: 278-282, *2 figs.*, 1918.

Myceloblastanon pseudoalbicans Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from sputum of bronchitis patient. No trace of stomatitis or other symptoms of *M. albicans* infection. Subcutaneous inoculation of yeast cells into guinea pig formed an abscess, which was resorbed. Intravenous injection into ear of rabbit caused death. Organism recovered from blood; kidneys, especially, hypertrophied and widely invaded by parasite.

In sputum, hyphae 2-4μ in diameter, dissociating into short, rectangular arthrospores. Lateral and terminal yeast cells. On carrot and Sabouraud glucose, yeast forms develop first. Later, as medium dries, mycelium of septate, branched hyphae with lateral or terminal spherical chlamydospores, 10-11μ in diameter.

CANDIDA

Candida Berkhout, De Schimmelgeslachten Monilia, Oidium, Oospora en Torula 63, 1923, excl. syn.

The type species is *Candida vulgaris* Berkhout based on a culture isolated by Kloecker under the name *Monilia candida* but evidently not that species.

Colonies membranous, thick, radially folded or areolate, with tufts of hyphae giving the colony a velvety appearance; margins not lobulate; blastospores often thick-walled, similar to arthrospores, others ovoid or irregular, sometimes pyriform and suggesting conidia, often very large, 7-10μ. Pseudomycelium well developed, hyphae little branched, flexuous, not easily breaking apart, ends of cells flattened, cells filled with fine oil globules. Terminal cell of hypha variable, often being a chlamydospore of variable form, rarely a chain of chlamydospores; coremia abundant, verticils more or less regular, composed of a few pyriform blastospores (Fig. 47, *9*).

All but one of the species of this genus so far reported attack the respiratory tract. One is suspicious that the extremely slender mycelium of *C. bethaliensis* belongs in *Actinomyces*.

Key to Species

Only glucose and fructose fermented.	
No pellicle on liquid media.	*C. urinae.*
Pellicle on liquid media.	*C. Krusei.*
Maltose also fermented, no pellicle.	
Cells very slender, 0.75-1.5μ in diameter, no pellicle.	*C. bethaliensis.*
Cells normal, 3-4μ in diameter.	*C. tumefaciens.*
Sucrose also fermented but not maltose, cells 2-3.5μ in diameter.	*C. rhoi.*

Candida urinae Dodge, n. sp.

Oidium Stamm I Gentzsch, Über pathogene Sprosspilze bei Diabetes, Inaug. Diss. Med. Fak. Univ. Jena, 30 pp., 1908.

Isolated from urine of a diabetic, drawn from the bladder under sterile conditions. Pathogenic for rabbits and mice.

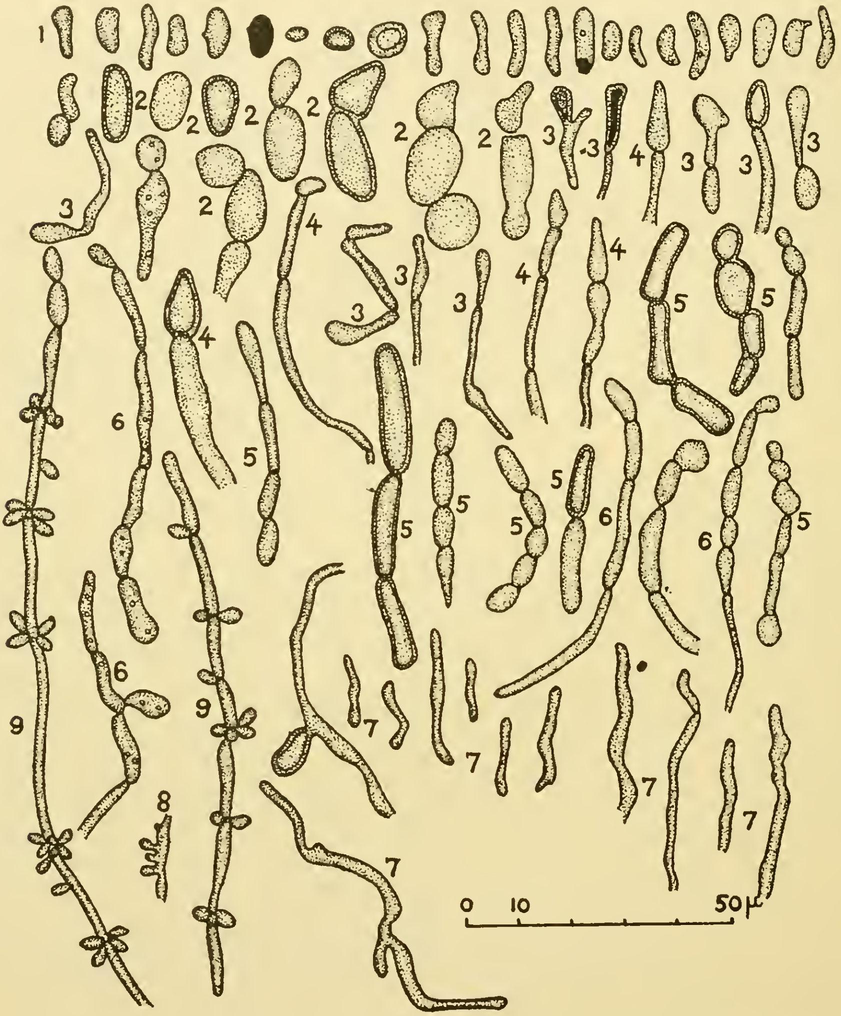

Fig. 47.—*Candida* (*Geotrichoides* Langeron & Talice). *1,* irregular blastospores; *2,* giant blastospores; *3,* clavate tips; *4,* inverted clavate tips; *5,* chains of arthrospores: *6,* typical bits of mycelium; *7,* sinuous hyphae; *8,* pyriform blastospores; *9,* hyphae with verticils of blastospores. (After Langeron & Talice 1932.)

Yeast cells spherical or ovoid, occasionally some filaments seen in old cultures.

On agar, colonies white, confluent, dull, the deeper ones somewhat yellowish. On gelatin, colonies similar to agar but growth slower. On potato, growth good, similar to that on agar. On alkaline broth and glucose broth, a granular precipitate on the walls of the tube but no pellicle, flocculent sediment. On malt extract, a ring but no pellicle. Glucose and fructose fermented after 3 days; acid produced with inulin, maltose, sucrose, lactose, and galactose. No action on milk or gelatin.

Candida Krusei (Castellani) Basgal, Contr. Estudo Blastomycoses Pulmonares 50, 1931.

Saccharomyces Krusei Castellani, Philippine Jour. Sci. B **5**: 197-203, 1910.

Endomyces paratropicalis B Castellani, Centralbl. Bakt. I, **58**: 236-238, 1911.

Endomyces Krusei Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912; Arch. de Parasitol. **16**: 184-186, 1913.

Monilia Krusei Castellani & Chalmers, Man. Trop. Med. ed. 2, 826, 1913.

Myceloblastanon Krusei Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Geotrichoides Krusei Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 67, 1932.

?Mycoderma Krusei Stovall & Bubolz, Jour. Infect. Dis. **50**: 73-88, *3 figs.*, 1932.

Geotrichoides tumefaciens Talice & Mackinnon, Reunión Soc. Argentina Patol. Reg. Norte **8**: 162, 1933.

Found in sputum of a convict suffering from a severe cough, other symptoms obscure. Case under observation for two months. *Monilia tropicalis* also present. Castellani also reports this organism in a case of urethritis with yellow discharge in a Serbian officer.

On glucose agar, very thick growth (Fig. 48). On other agars, delicate, whitish growth. On serum, white growth. Broth and other liquid media remain clear with pellicle of variable thickness and light sediment. Glucose and fructose litmus broth fermented and acid produced, no change with other sugars. No acidification or coagulation of milk. Coagulated serum not liquefied.

Gram-positive. Creamy white, dull surface. Cells oval.—Zepponi (1931).

Candida bethaliensis (Pijper) Dodge, n. comb.

Monilia sp. Pijper, Med. Jour. S. Africa **12**: 129-130, 1917.

Monilia bethaliensis Pijper in Castellani & Chalmers, Man. Trop. Med. ed. 3, 1091, 1919.

Myceloblastanon bethaliense Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from sputum of patient suffering from cough, periods of feverishness, bronchitis, hyperleucocytosis. Sputum whitish yellow. No tubercle bacilli found. Vaccine treatment improved but did not cure cough. Inoculation to rabbit proved fatal in 48 hours. Hemorrhages in lungs. Organism not recovered.

Cells 0.75-1.5μ in diameter. Septate hyphae up to 80μ in length.

On Sabouraud agar, growth in a uniform whitish layer with yellow tinge. No filament formation. On potato, growth slightly verrucose and yellower, with filament formation. In gelatin, a fir-tree arborescence formed. Sediment forms in broth, liquid remaining clear. Acid formation and fermentation of maltose and glucose, acid only with sucrose, no action with lactose, dextrin, or mannite.

Candida tumefaciens (Pollacci & Nannizzi) Dodge, n. comb.

Saccharomyces tumefaciens albus Foulerton, Jour. Path. Bact. **6**: 37-63, *Pl. 4*, 1900.

Monilia tumefaciens alba Ota apud Motta, Atti R. Accad. Fisiocrit. Siena IX, **17**: 639-654, *4 figs.*, 1926.

Monilia tumefaciens Pollacci & Nannizzi, I Miceti Patog. No. 55, 1927.

Myceloblastanon tumefaciens album Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

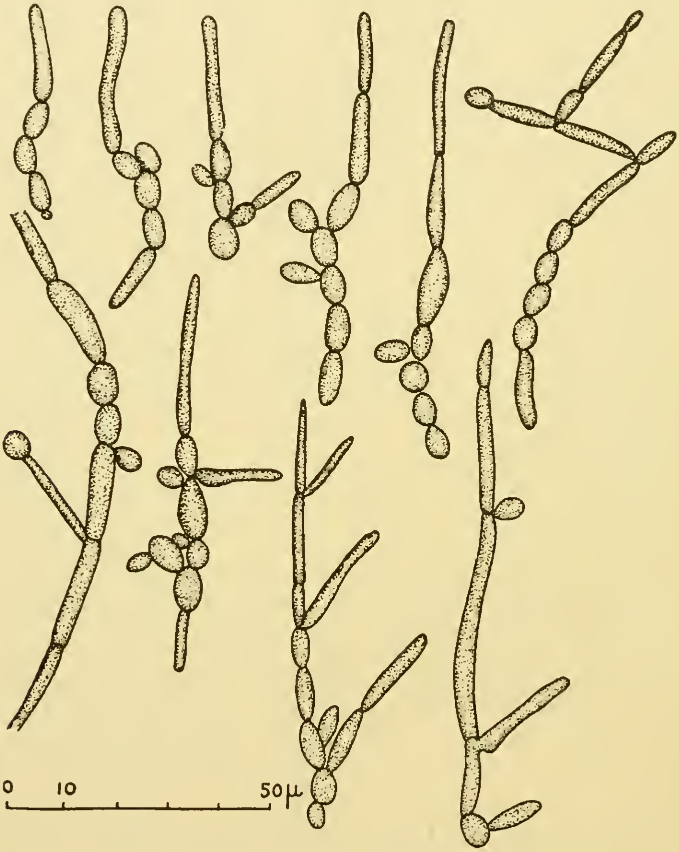

Fig. 48.—*Candida Krusei* showing intercalary chains of blastospores or arthrospores (?). (After Langeron & Talice 1932.)

Geotrichoides tumefaciens Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 68, 1932.

Isolated from two cases of pharyngitis along with *Corynebacterium diphtheriae.* Pathogenic to rabbit, producing tumors at point of inoculation and small nodules elsewhere.

Cells 3-4μ in diameter. No mycelium or spores observed. Case of Motta shows chains of cells, some elongate, terminal cell swollen, hyphae simple or branched, cells cylindric, 18-30 × 3-6μ, ending in chains of ovoid blastospores. Grows at 22°, better at 37° C. Gram-positive.

On nutrient agar and nutrient glucose agar, growth spreading, thick white, moist. On potato, growth dry and white becoming brownish. On coagulated serum, growth scanty, dry, thin, white. Growth in peptone broth scanty, liquid clear, no surface growth, sediment in bottom of tube. In alkaline litmus milk, growth good, no coagulation, no acid. Glucose rapidly fermented, maltose slowly, no action on lactose.

Candida rhoi (Castellani & Chalmers) Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Endomyces rhoi Castellani & Chalmers, Man. Trop. Med. ed. 1, 601, 1910.

Monilia rhoi Castellani & Chalmers, Man. Trop. Med. ed. 2, 828, 1913.

Parasaccharomyces rohii Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 272-273, 277, 1918.

Myceloblastanon rhoi Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated in case of otomycosis, also from tea samples.

Mycelium septate, 2-3.5μ in diameter, and spherical free "spores," 3.5-5μ in diameter, also arthrospores and intercalary chlamydospores.

Acid formation and fermentation with glucose, fructose, and sucrose, slight with galactose. Very slight acid with maltose. No coagulation of milk. No liquefaction of gelatin or coagulated serum.

Doubtful Position

The following species are too poorly described to refer here with certainty but probably belong here.

Monilia Fioccoi Pollacci & Nannizzi, I Miceti Pat. Uomo Anim. 8; No. 77, 1928.

Isolated from a man in Venice suffering from diffuse dermatosis with numerous ulcerous pustules, chiefly on the upper part of the body and arms (for additional case, see Zoon 1930, 1931).

Cells ovoid, ellipsoid or spherical, minutely guttulate (one or many), occurring singly, sometimes together in short chains 7.3-9.7 × 3.5 or 7-8μ in diameter; hyphal cells cylindric, elongate, rounded at each end, easily separating, not or rarely branched, producing terminal chains of ovoid blastospores 7.3-7.5 × 4.8-5μ. Chlamydospores terminal, spherical, 7-8μ in diameter, uniguttulate, granular.

On Pollacci agar, colonies punctiform, small, 0.5-2 mm. in diameter, smooth, dirty white, confluent, moist. On Sabouraud agar, colonies remain isolated and become yellowish in age. Glucose, fructose and sucrose fermented.

Trichosporum Asahii Jap. Jour. Derm. Urol. **29**: 733-773, 1929.

Lesions appear as red nodules growing to 5 cm. in diameter, circular, crateriform, eventually producing thin yellow crusts, accompanied by pruritus.

Blasto-, arthro- and chlamydospores present. Gram-positive.

Cultures unfortunately not described in the summary.

SCHIZOBLASTOSPORION

Schizoblastosporion Ciferri, Arch. Protistenk. **71**: 446-448, *Fig. 6,* 1930.

The type species is *Schizoblastosporion Starkeyi-Henricii* Cif. (*Torula A* Starkey & Henrici 1930.)

Colony creamy, white, or slightly yellowish. Turbidity and sediment on liquid media, sometimes a trace of a ring but no pellicle present. Blastospores spherical or slightly ellipsoid; mycelial cells elongate, ellipsoid; pseudomycelium somewhat branched. No fermentation of sugars; gelatin liquefied.

This genus is not well known, but three organisms of skin and nails seem to belong here. The genus seems intermediate between *Geotrichum* and *Parendomyces.*

Key to Species

Margin smooth; colony on malt agar smooth with central elevation; from nails, Austria. *S. gracile.*

Margin festooned or dentate.
  Colony on malt agar smooth; from nails, Austria. *S. globosum.*
  Colony on malt agar umbilicate, surface wrinkled; from vesicular lesions of the feet, Japan. *S. tokioense.*

Schizoblastosporion gracile (Zach) Dodge, n. comb.

Blastodendrion gracile Zach in Wolfram & Zach, Arch. Derm. Syphilis **169**: 95-104, *5 figs.,* 1933.

Isolated from a case of onychomycosis in Austria.

Cells spherical to ovoid, 2.7-3.2 × 6.5, mostly 5.4 × 6.5μ. Mycelial cells elongate, ends rounded, 2.5-3.2 × 19.5μ, thin-walled with one small oil globule when young, later with a gelified wall, a large central vacuole, and 1-2 oil globules. Sprouting only at the poles. No ascospores.

Colonies on maltose agar, dull, whitish, smooth with a smooth margin, later yellowish with a central elevation but without folds, margins sometimes showing pseudomycelial outgrowths. On gelatin, colony thin, white dull, margin wavy, slightly sinking into the medium. On acid potato, colony thicker, smoother more shining, grayish yellow. On carrot, colonies similar but white. In maltose broth and in yeast water, sediment slightly flocculent, no turbidity, no pellicle. In yeast water sometimes a slight turbidity. Growth good at 37° C. No fermentation, gelatin liquefied in 3 weeks.

Schizoblastosporion globosum (Zach) Dodge, n. comb.

Blastodendrion globosum Zach in Wolfram & Zach, Arch. Derm. Syphilis **169**: 95-104, *5 figs.,* 1933.

Isolated from a case of onychomycosis in Austria.

Cells spherical, mostly 5-5.5μ, giant cells up to 10.8-12.8μ. Pseudomycelial cells elongate up to 30μ long, slender, producing short ellipsoid blastospores, sometimes almost lacrimiform, in depauperate whorls. Sprouting not confined to the poles. No ascospores.

Colonies on maltose agar dull, smooth, white, later slightly yellowish, margin wavy to dentate, sometimes showing pseudomycelial outgrowths. On gelatin, colony similar but weaker, somewhat striate and verrucose, margin wavy, slowly sinking into the medium. On acid potato and carrot, colony thick, grayish yellow, more or less moist and shining. In maltose broth and in yeast water, sediment developed in 4 days, no turbidity and no pellicle. Growth good at 37° C., no fermentation, gelatin liquefied slowly after 1 month, becoming complete in 2½ months.

Schizoblastosporion tokioense (Fujii) Dodge, n. comb.

Myceloblastanon tokioense Fujii, Jap. Jour. Derm. Urol. **31**: 959-983, *15 figs.* [71-72], 1931.

Isolated from lesions on toes of young Japanese woman. Lesions began as a depression on the top of the foot near the toe, in time becoming whitish and more visible, progressing between the toes as erythematous vesicles which ruptured. Ulcerations became dry and formed a crust all over the toes. Vesicles and pustules abundant, reddish, covered by crust. Pruritus present. Intraperitoneal injection into mice caused enlargement of the abdomen, then death.

In crust, organism shows spherical, ovoid, or angular cells, 10-7.5-5.5μ in diameter, mostly thick-walled, some thin-walled and 2.7-3μ in diameter, not colored. Hyphae flexuous. On malt glycerol agar, cells long-ovoid, 10 × 7.5μ, showing distinct vacuoles and chromatin granules, in chains or dendroid, dichotomous groups, slender, delicate, swollen in places. No spores on Gorodkova agar.

On Sabouraud agar in ten days, colony round, with margin sunk into medium and center umbilicate, becoming elevated with radiating wrinkles which start at center or in between but never reach margin, yellow gray above, reverse not colored. Growth best in drier parts. Hyphae seldom penetrate medium. After 20 days, center slightly depressed, radiations reach the margin which also is slightly depressed, surface otherwise flat, colony moist yellowish brown, reverse uncolored, medium not colored. On malt agar, colony 2.5-3 cm. in diameter, center slightly depressed, surface furrowed, part wet, part dry, margin comparatively transparent, partly sunk in medium. At the optimum temperature, colony finally 6 cm. in diameter, yellowish white with denticulate margin, center moist, umbilicate, wrinkled, slightly elevated, with short furrows, margin sunken with filaments projecting into medium. On malt glycerol agar, colony round, 2 cm. in diameter, center dry, irregularly wrinkled, elevated with radiating wrinkles. Margin moist. In malt extract, liquid is cloudy with a flocculent sediment. No fermentation of sugars, acid formation with glucose, xylose, and rhamnose.

PSEUDOMYCODERMA

Pseudomycoderma Will, Centralbl. Bakt. II, **46**: 278-281, 1916.

The type species is *Pseudomycoderma vini* Will.

Cells fusiform, with 1-3 oil globules, shorter cells citriform suggesting those of *Pseudosaccharomyces*, also small spherical cells with a single oil globule. Pseudomycelium branched, of long slender cells, terminal portions of the branches not forked. Pellicle developing rapidly on malt extract, at first small islets, resembling a drop of fat, then confluent but still showing the points of union of the separate islets, the upper portions becoming chalk-white, gas bubbles collecting under the pellicle. In old cultures, the pellicle is compact and tough, brownish or slightly reddish. On other liquid media, the islets are rapidly confluent, the pellicle is vigorous, smooth, white, and glassy, easily sinking to the bottom. Colony folded, center crateriform, upper portions of the fold chalky. Gelatin slowly liquefied; sugars fermented; hydrogen sulphide produced in mineral nutrient solutions to which powdered sulphur is added.

Key to Species

Glucose fermented, colony white or brownish.	*P. Rabesalama.*
Glucose, galactose, and sucrose fermented, colony white.	*P. vesica.*
Glucose and lactose fermented, colony yellow to brick red.	*P. Tanakae.*
Glucose and mannite fermented, colony grayish.	*P. fecale.*
Glucose, mannite, lactose, and sucrose fermented.	*P. Mazzae.*

Pseudomycoderma Rabesalama (Fontoynont & Boucher) Dodge n. comb.

Mycoderma Rabesalama Fontoynont & Boucher, Ann. Derm. Syphiligr. VI, **4**: 330-338, *Figs. 7, 8,* 1922.

Geotrichum Rabesalama Basgal, Contr. Estudo Blastomicoses pulmonares 50, 1931.

Isolated from abscess of lung with hemoptysis. Abscesses on rabbit heal spontaneously. Retroculture negative.

Fungus produces rods with square ends, 20-25 × 4-4.5μ, filaments up to 160μ in length, 3μ in diameter, terminal cells sometimes long and pointed, forming greatly branched holdfasts in contact with glass of culture vessel. On second day floating rods detach from filaments.

On glucose agar, colony shows on third day, center 3-4 mm., elevated, with white rays. ''Poor'' agar as above, but rays raised from surface of agar. Maltose agar, same as glucose, but base gray ''star'' brown. On potato, culture is light, velvety, same color as medium. Potato glycerol, white, dry lumpy. Gelatin glucose, colony white powdery with very slow liquefaction after 5 months. Glucose broth, uniformly turbid with eventual formation of thick pellicle, turbidity settles, finally also pellicle; on shaking, gas is evolved (fermentation of glucose).

Pseudomycoderma vesica (Harrison) Dodge, n. comb.

Mycotorula vesica Harrison, Trans. R. Soc. Canada, Biol. Sci. **22**: 219, 1928.

Isolated from the urinary bladder, Rigshospitalet.

From young malt agar colonies, cells ellipsoid, cylindric or irregular, budding at the ends and septa, ellipsoid cells 5 × 3.3μ, cylindric cells 10 × 2μ. From pellicle on 56-day-old malt extract cultures, cells more variable in shape, oil globules more abundant, spherical cells 4μ in diameter, cylindric cells 15 × 1.8μ, ellipsoid cells 6 × 4μ, some hyphae present.

On B. P. B. agar, colony spreading, shining, bluish with white margin. On malt gelatin, colony slightly crateriform with radial markings, margin slightly wrinkled, white waxy. On potato, colony wrinkled to vermiculate.

On malt extract, a pellicle produced, liquid turbid and remains so, sediment heavy. Sucrose inverted, glucose, mannose, fructose, galactose, and sucrose fermented with acid production, acid production in arabinose and maltose. In xylose, rhamnose, mannite, maltose, lactose, and raffinose a pellicle is produced without acidity; in glycerol, sorbite, dulcite, salicin, inulin, and dextrin only a ring is formed. Milk slightly akaline without coagulation or digestion. Gelatin liquefaction slow, becoming complete in 56 days. Anaerobic growth (under olive oil) slight, growth good between 25° and 37° C.

Pseudomycoderma Mazzae Dodge, n. sp.

Monilia sp. Mazza & Niño, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **4**: 545-558, *15 figs.*, 1927.

Isolated from hemoptoic expectorations of a patient suffering with cough and pains in the thorax. Pathogenic to guinea pig, rat, and mouse, producing generalized infection with lesions at a distance from the point of inoculation.

Filamentous forms present on most media along with abundant yeast cells, few large, spherical, thick-walled cells. Hyphae of variable diameter, about 1.5-2μ, flexuous, rarely branched. Yeast cells singly or in groups. Hyphae rare on solid media. On carrot glycerol, yeast cells and broad bacilliform cells. On potato glycerol, abundant yeast cells of small dimensions. Gram stain inconstant, not acid-fast. Growth good at 37° and 20° C.

On Sabouraud agar, good growth, colony much folded and contorted. Drigalski medium changes color in 24 hours, slight gas in 4 days, then decolorized. Litmus sucrose agar color change in 24 hours. Neutral red color change in 72 hours. On mannite, lactose, or glucose + litmus agar, color change in 24 hours. In broth, slight pellicle in 24 hours, with uniform turbidity and sediment. In acid Raulin solution, slight development, with sediment only. Ferments sucrose, levulose, lactose, arabinose, maltose, mannite, raffinose, slightly galactose, glucose, dulcite, inulin. No indol formation. Growth is strictly aerobic. Coagulated serum not liquefied. Milk coagulation begins in 24 hours and is complete in 4 days. Gelatin liquefied, with gas formation.

Pseudomycoderma Tanakae Dodge, sp. nov.

Saccharomyces sp. Tanaka, Mitt. Med. Ges, Tokyo **28**: 1914; Jour. Path. Bact. **25**: 350-355, *Pl. 18,* 1920.

Found in swollen mesenteric glands in 12 cases of cancer of stomach or intestines. Not pathogenic to mice, guinea pigs, or rabbits.

Cells ellipsoid to fusiform, 2-6.6 × 1.5-3.7μ, yellowish, not easily staining. Spores 1-10μ in diameter, sometimes 16μ. [Spores here described are probably only granules since author states that in rapidly growing cells spores become smaller and very numerous. "Spores" stained by Moeller's and Klein's method.] Optimum temperature for growth 25° C.

Grown on several different media, colonies vary between yellow and brick red in color. Pigment best developed on potato, less at 37° C., than at room temperature. Fermentation of lactose and glucose.

Pseudomycoderma fecale Dodge n. sp.

"Mycoderme" LeDantec, C.R. Soc. Biol. **74**: 412-413, 1913 [Gaz. Hebdom. Sci. Méd. Bordeaux **34**: 83, 1913].

Monilia de LeDantec Sartory, Champ. Paras. Homme Anim. 709, 710, 1922.

Isolated from the feces of two sailors ill with nautical beriberi. Not pathogenic on hypodermic injection to mouse, guinea pig, or hen. Intraperitoneal injection in guinea pig produced peritonitis.

Growth on glucose agar, thick, creamy, grayish, center thickest, two marginal zones thinner. Surface moist, not velvety but rough with points, suggesting the surface of a stormy sea. Hyphae penetrate agar. No color change on ageing. In Sabouraud media, colonies appear in 24 hours and in 48 hours grow onto walls of tube. On potato, colony is gray; on carrot, colony is white, creamy. On gelatin stab, growth resembles inverted fir tree. In broth, a silky pellicle forms and sinks to bottom, liquid is cloudy. In glucose broth, there develop an ethereal odor and acid reaction which in about 3 weeks give way to fetid odor and alkaline reaction. In peptone broth, the fragile pellicle soon sinks while another forms, wide ring, liquid turbid and of fetid odor. In milk, a pellicle forms, soft curd, acid at first, and then alkaline and fetid. Glucose and mannite fermented, lactose slightly, maltose and sucrose not at all. Milk coagulated. Gelatin liquefied in 25-30 days. Growth slow under anaerobic conditions.

Doubtful Position

The following species, perhaps saprophytes, isolated from cases of lingua nigra pilosa, may belong here but are too poorly described for certain determination.

Oospora catenata Schaede, Derm. Woch. **98**: 521-527, 1934.

Isolated from lingua nigra pilosa.

Mycelium 6-7μ in diameter, cells ellipsoid, 6-8.5 × 8-15μ, or spherical 8-10μ in diameter, clinging together in short chains.

Colonies on malt agar dull, glassy white with slight grayish tinge, somewhat rough. On carrots, colonies thick white, also on liquid media.

Oospora fragilis Schaede, Derm. Woch. **98**: 521-527, 1934.

Isolated from lingua nigra pilosa.

Mycelium 6μ in diameter, easily separating into single cells. Ellipsoid cells 5-8 × 7-13.5μ, spherical cells 5-7μ in diameter.

On malt agar, colonies white, powdery, smooth; colonies thinner on carrots and on liquid media.

PARENDOMYCES

Parendomyces Queyrat & Laroche, Bull. Mém. Soc. Méd. Hôp. Paris III, **28**: 111-136, 1909.

The type species is *Parendomyces albus* Queyrat & Laroche.

Colony creamy, mycelium scanty, limited to short chains in liquid media, cells ellipsoid; chlamydospores abundant; no ascospores. Pellicle formation rare, rings more common on liquid media, gelatin not liquefied, sugars not fermented.

Species which have been very poorly described as to morphology have been referred here if their biochemical reactions warranted, on the ground that if the morphology were distinctive, it would have been described. The genus as here treated is probably heterogeneous. It is found principally on mucous membranes, producing vaginitis, bronchitis, and enteritis, not producing subcutaneous abscesses as far as known.

Key to Species

Milk clotted.	
Colonies white.	
Serum liquefied, from perionychia.	*P. periunguealis.*
Serum not liquefied, from bronchitis.	*P. zeylanoides.*
Colonies yellowish.	
Growth on broth cloudy; from vaginitis.	*P. albus.*
Growth on broth clear; isolated from sputum.	*P. zeylanicus.*
Milk not clotted.	
Colonies yellowish, isolated from sputum.	*P. zeylanicus.*
Colonies white.	
No acid formed in sugars.	
Cells 4-5μ; from macroglossia.	*P. macroglossiae.*
Cells 6-6.5μ; from cutaneous abscesses.	*P. Hessleris.*
Acid with glucose and maltose.	*P. inexorabilis.*
Acid with maltose and galactose.	*P. Perryi.*
Acid with maltose, galactose, and sucrose.	*P. Blanchardi.*
Reaction with sugars unknown.	
Isolated from vaginitis.	*P. vaginalis.*
Isolated from intestinal tract in sprue.	*P. Vanderburgii.*
Reaction with milk unknown.	
Reaction with sugars unknown.	*P. Krausi.*
Acid with glucose, sucrose, and maltose.	*P. butantanensis.*
Acid with glucose, sucrose, maltose, and dextrin.	*P. Vuillemini.*
Acid with glucose, sucrose, maltose, dextrin, and galactose.	*P. communis.*
No acid with sugars.	*P. enterocola.*

Parendomyces periunguealis (Niño) Dodge, n. comb.

Monilia periunguealis Niño, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **5**: 270-283, 1930.

Monilia sp. Swartz, Arch. Derm. Syphilol. **18**: 74-78, *5 figs.*, 1928.

Mycotorula albicans Talice & Mackinnon, Reunión Soc. Patol. Reg. Norte Santiago del Estero **8**: 161, 1933.

Isolated from two cases of perionychomycosis in Argentine women. In one case, the finger nail was deformed, rough and dull, with longitudinal striations. Cuticle and skin of both cases loose and thickened at edge, exuding greenish yellow pus on pressure. Yeast isolated from pus. Amelioration by treatment with $KI.I_2$ and alkaline washes. Final cure effected by irradiation with x-rays. Pathogenic to rabbit, guinea pig, and rat.

In pus, yeast cells mostly spherical, some sprouting, more or less refringent. In culture on either solid or liquid media, at first only sprouting forms appear. Yeast cells which are variable in size, 2-4μ, spherical or ovoid, form chains of 3-4 cells when the sprouting is bipolar, or in groups when sprouting is multipolar. These cells have a thin wall, more or less granular content, and a rather large vacuole which is almost always central. After a while hyphal forms appear, composed of mother cells and blastospores, rich in protoplasm and of very variable size. Others are made up of several long cells. Blastospores lateral, spherical, or ovoid in form. Growth good both at room temperature and at 37° C. Mostly gram-positive, though in part negative. With Guéguen stain colored an intense blue.

On solid media, colonies at first hemispheric, creamy, humid, not adherent to medium. With age the center flattens while the edge curves gradually downward to the medium. Good growth on Sabouraud glucose agar, potato or carrot and glycerol, or gelatin. Scant growth on agar in 4 days. In simple broth or Sabouraud glucose broth, good growth in 48 hours with the formation of a pulverulent sediment on the sides of the tube. Starch paste not liquefied. Probably no fermentation of sugars, although the author reports slight fermentation of arabinose and maltose, more of inulin. Milk coagulated in 48 hours with acid formation and partial digestion of clot. Coagulated human serum digested. Gelatin not liquefied.

Parendomyces zeylanoides (Castellani, Douglas & Thompson) Dodge, n. comb.

Monilia zeylanoides Castellani, Douglas & Thompson, Jour. Trop. Med. Hyg. **28**: 257-258, 1925.

Isolated from a case of bronchial infection, but case history not given.

Colonies white, lead agar not darkened. No fermentation. Litmus milk clotted. No liquefaction of gelatin.

Parendomyces albus Queyrat & Laroche, Bull. Méd. Soc. Méd. Hôp. Paris III, **28**: 111-136, 1909.

Cryptococcus albus Castellani & Chalmers, Man. Trop. Med. ed. 3, 1080, 1919.

Monilia alba Sartory, Champ. Paras. Homme Anim. 707, 1923, not Castellani, 1911.

Candida alba Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Isolated from little white spots on surface of the vagina. Spots easily washed off but recurrent within 12 hours. Patient experienced burning sensation and was unable to sit or sleep. Irrigation with a variety of antiseptics twice a day gave relief, but no cure. Finally arrested by a dressing of creosote and olive oil (20 gm. to 60 gm.). Rabbits, rats, mice, and guinea pigs found susceptible. Pigeons, monkeys, and kittens not susceptible.

In the yeastlike form, cells are ovoid, slightly pointed at each extremity, sometimes pyriform, more rounded in age. Length 3.4μ, width 2.3μ, with extreme variations $6\text{-}2.5 \times 4.5\text{-}1\mu$. Easily stained with aniline dyes. Gram-positive. Filamentous forms appear only in liquid media and are rarely 8-10 cells long. Reproduction is by budding and chlamydospores which are from two to three times the size of ordinary cells, thick-walled and not staining well. These are abundant in Naegeli liquid to which 2% sucrose has been added and are 12-15μ in diameter. Ascospores not seen.

On ordinary agar, and sugar agars colony is yellowish white, thick, glistening, creamy. Growth on potato plug slow, potato becomes brown, colonies somewhat dry and in rounded groups, not bands. Best growth on carrot plug placed in glycerol-glucose solution (100 c.c. water, 10 c.c. glycerol, 5 gm. glucose). After 12 hours at 38° C., the white colonies are thick at the center, confluent. Liquid cloudy at first, then clear with whitish deposit. Pellicle forms between carrot and glass. Growth stops in 3 days. At lower temperatures, growth slower. Color of carrot not modified, as the growth is strictly aerobic. On potato, in glycerol-glucose solution, growth is similar to that on carrot, but more rapid. On gelatin stab, abundant growth appears at stab on surface, then scattered colonies but no growth below. On gelatin streak, margin finely toothed, thicker in lower part. No mycelial forms on gelatin. On coagulated serum, growth is good, colonies chalky white. In broth, ordinary or slightly acid, growth shows as cloudiness with abundant yellowish white sediment, sometimes a slight ring but no pellicle. In glycerol broth, growth is rapid with yeast cells only. In alkaline broth, much less abundant. In broth and alcohol (6 drops of alcohol to 6 c.c. broth), growth is poor at first, then good with occasional filaments of 3-4 cells appearing. In malt extract, growth rapid and abundant, white. [*Syringospora albicans* grows very poorly in this.] In red wine, growth is poor, yeast cells only. On media, colored with methylene blue or sky blue, organism grows well and assumes a greenish blue hue. Milk coagulated in 3-7 days. Gelatin not liquefied.

Parendomyces zeylanicus (Castellani) Dodge n. comb.

Endomyces zeylanicus Castellani, Arch. de Parasitol. **16**: 184-186, 1913.

Monilia zeylanica Castellani & Chalmers, Man. Trop. Med. ed. 2, 826, 1913.

Parasaccharomyces zeylanicus Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 273-274, 278, 1918.

Myceloblastanon zeylanicum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida zeylanica Basgal, Contr. Estudo Blastomycoses Pulmonares 50, 1931.

Castellani isolated this organism from sputum. Froilano de Mello & Gonzaga Fernandes found it as a laboratory contaminant.

Colony yellowish, acid with glucose, fructose, maltose, galactose, sucrose, dextrin; slight acid with lactose; very slight acid with inulin and raffinose. Litmus milk acid with slight coagulation. Gelatin and serum not liquefied.

Parendomyces macroglossiae (Castellani) Dodge n. comb.

Monilia macroglossiae Castellani, Jour. Trop. Med. Hyg. **28**: 219-221, 1925; Am. Jour. Trop. Med. **8**: 389, 1928; Re, Jour. Trop. Med. Hyg. **28**: 317-319, 1925.

Torulopsis macroglossiae Castellani & Jacono, Jour. Trop. Med. Hyg. **36**: 314-315, *Figs. 40-42*, 1933.

Isolated from a case of macroglossia. Tongue enlarged, occasionally painful, without the usual verrucoid patches of blastomycosis.

Cells ovoid, 4-5μ in diameter, gram-positive, not acid-fast.

On ordinary agar and glucose agar, growth good, smooth, white. A little mycelium in liquid cultures. No fermentation of any sugar-peptone medium. Sometimes a slight acidity is produced with glucose. No change in litmus milk. Serum and gelatin not liquefied.

Parendomyces Hessleris (Rettger) Dodge, n. comb.

Blastomyces Hessleris Rettger, Centralbl. Bakt. I, **36**: 519-527, *2 pls.*, 1904.

Cryptococcus Hessleri Castellani & Chalmers, Man. Trop. Med. ed. 2, 771, 1913.

Torulopsis Hessleri Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from papules which slowly developed into abscesses following a cut while shaving. Pathogenic to rabbits, white mice, and guinea pigs [case of Hessler, 1898].

Cells spherical or slightly ovoid, 6-6.5μ, in malt extract becoming 9-10μ. In animal tissue cells form mycelium; cells often sprout as many as 7-8 daughter cells, mostly in a group at one end of the parent cell. No capsule or ascospores noted. Hessler (1898) noted mycelium but did not describe its morphology.

On agar, colonies white, opaque, circular. On gelatin, colonies small, white, circular, slightly elevated. In blood serum colonies light cream color. On potato, colony light cream color, texture cheesy. On beet, colonies coarsely granular, growth better. In broth, a fine sediment, liquid clear, no pellicle, hyphae occasionally seen. In malt extract, sediment heavy, grayish white with a thin grayish pellicle. No acid or fermentation with sugars. No action on milk. No liquefaction of gelatin.

Syringospora inexorabilis (Mazza & Palamedi) Dodge, n. comb.

Monilia inexorabilis Mazza & Palamedi, Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán **7**: 424-467, *1 pl., 50 figs.*, 1932.

Mycotorula candida Talice & Mackinnon, Reunión Soc. Argentina Patol. Reg. del Norte en Santiago del Estero **8**: 165, 166, 1933.

Lesion began in the commissural surface of the lips, edematous, spreading to the gingival mucosa, tongue, and interior of the mouth generally, producing ulcers. Thence it spread to the lungs (x-ray) the organism being isolated from sputum. Ulcers then appeared on the arms and foot. The disease proved fatal, autopsy showing the lungs to be the principal internal focus of infection.

Yeast cells in tissues and pus spherical, somewhat suggesting the picture with *Zymonema dermatitidis*. Yeast cells predominate in cultures, but hyphae seen in potato decoction and serum.

On Sabouraud glucose, colony white, creamy, slightly drier at the periphery, margin festooned, only yeast cells seen in the first 22 days. On simple agar and 3% glycerol agar, potato and potato-glycerol, growth similar but some hyphae noted in 14 days at 37° C. On liquid media, broth remains clear with a thick sediment at the bottom of the tube. No fermentation, producing acid with glucose and maltose only. Produces an inverted pine tree in gelatin stab, without liquefaction; egg albumen not digested, milk not coagulated.

Data secured in my laboratory while this book is in page proof, indicate that this species belongs in *Syringospora* (see p. 272).

Parendomyces Perryi (Castellani) Dodge, n. comb.

Endomyces Perryi Castellani, Arch. de Parasitol. **16**: 184-186, 1913.

Monilia Perryi Castellani & Chalmers, Man. Trop. Med. ed. 2, 829, 1913.

Isolated from samples of tea dust.

Colony white, slightly acid and fermentation with fructose and sucrose, acid only with glucose, galactose, maltose; slightly acid with raffinose and inulin. Litmus milk not coagulated, decolorized, slightly acid then alkaline; no action on serum or gelatin.

Parendomyces Blanchardi (Castellani) Dodge, n. comb.

Endomyces Blanchardi Castellani, Arch. de Parasitol. **16**: 184-186, 1913.

Monilia Blanchardi Castellani & Chalmers, Man. Trop. Med. ed. 2, 829, 1913.

Isolated from tea dust.

White, smooth growth on maltose, glucose, and other sugar media. Slight fermentation of glucose, none of other sugars. Acid formed with fructose, maltose, galactose, sucrose; very slightly acid with raffinose and inulin. Milk at first slightly acid, then alkaline. Neither coagulated serum nor gelatin liquefied.

Parendomyces vaginalis (Mazza & Los Ríos) Dodge, n. comb.

Monilia vaginalis Mazza & Los Ríos. Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires, **6**: 216-225, *13 figs.*, 1931, not Escomel.

Isolated from viscous secretion of vagina in an Argentine woman suffering from vaginitis. Authors unable to follow case to end, although case considerably improved by applications of $KI.I_2$, and of Lugol solution and glycerol in equal parts alternating with alkaline washes. Intravenous injection killed rabbit in 50 hours. All of the internal organs showed this species.

Cells elongate, forming septate mycelium. Occasional blastospores solitary at septa.

On Sabouraud glucose agar, colonies round, of appearance of spots of stearine, viscous, confluent, not very adherent to medium and composed almost exclusively of yeast forms. On Drigalski medium, by puncture, growth on the surface with slight color change. Organism grows well on potato and glycerol, producing a white colony without pigmenting the medium. Similar on carrot and glycerol. In plain broth or with glucose, slight turbidity and sediment. Indol test negative. No fermentation with glucose, maltose, mannite, sucrose, dextrin, fructose, dulcite, arabinose, galactose, racemose, raffinose, lactose, or amygdalin. Coagulated human serum slowly liquefied, milk not coagulated, gelatin not liquefied.

Parendomyces Vanderburgii (Kohlbrugge) Dodge, n. comb.

Oidium Vanderburgii Kohlbrugge, Arch. Schiffs-Tropenhyg. **5**: 394-397, 1901 [name and case history]; Nederl. Tijdschr. Geneesk. **37**: 2: 881-890, 1901 [description without name].

Isolated from a case of sprue in the Dutch East Indies.

No discoloration of potato. No fermentation of sugars. Milk not coagulated but growth good, colonies milky white, not slimy, easily emulsifiable in water. Gelatin not liquefied.

Parendomyces Krausi (Ota) Dodge, n. comb.

Cryptococcus Krausi Ota, Derm. Woch. **78**: 229, 1924.

In 24 hours on malt agar, cells ellipsoid or ovoid, rarely spherical, average cells 6-7 × 10μ with several small oil drops, in branched chains which break up into individual cells. In a month, the chains have all disappeared and the oil drops are larger. No true mycelium formation. No fermentation.

Parendomyces butantanensis (Gomes) Dodge, n. comb.

Monilia butantanensis Gomes, Annaes Paulistas Med. Cirurg. **12**: 1924; Mem. Inst. Butantan, 1924.

Candida butantanensis Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 54, 1932.

Isolated from sputum of a case clinically resembling tuberculosis. Pathogenic for laboratory animals.

Cells 4-6μ in diameter, in pairs or short chains of 3-4 cells, spherical or ovoid, chains rather longer on carrot. No ascospores on Gorodkova agar.

On Sabouraud maltose, potato or carrot, colonies white, soft. and shining. In glucose broth, pellicle and sediment developed. No fermentation of sugars, acid with glucose, fructose, maltose, sucrose and arabinose, very slight with galactose and dextrin, no acid with inulin, mannite, and lactose. No action on coagulated serum or gelatin.

Parendomyces minor (Pollacci & Nannizzi) Dodge, n. comb.

Cryptococcus minor Pollacci & Nannizzi, apud Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 317, 1934.

Torulopsis minor Lodder, Anaskosporogenen Hefen **1**: 178-179, 1934.

Cryptococcus dermatitidis Benedek in Lodder, Anaskosporogenen Hefen **1**: 156-158, 1934 excl. all syn.

Isolated from the scales of a case of psoriasis? [psionasi Lodder] by Spicca & Tarentelli. Source of Benedek's culture unknown, probably from lesions clinically suggesting those of *Atelosaccharomyces hominis* or perhaps even *Zymonema dermatitidis*, as Lodder has confused it with these organisms.

Cells small, short ovoid, 2.5-4 × 3.5-5(-6.5)μ clinging together in short chains of 4-6 cells.

On malt agar, colony almost white, dull, center verrucose, margin almost smooth. On malt gelatin, yellowish, dull, center slightly elevated and of deeper color, margin slightly ragged. In malt extract ring white, well-developed sediment, and occasional floating islets. Good growth on alcohol; no fermentation, no liquefaction of gelatin.

Parendomyces Vuillemini (Froilano de Mello & Gonzaga Fernandes) Dodge, n. comb.

Endomyces Vuillemini Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 230-234, 1918, excl. syn.

Isolated five times from sputum in respiratory diseases.

Yeast cells, elongate cells, and septate, branched mycelium present.

On Sabouraud glucose agar, colonies dry, white, with margins indented, separable from the medium. Asci abundant, mycelial elements rare, chlamydospores terminal or intercalary. On neutral agar, colonies circular, 5-7 mm. in diameter, white, elevated, waxy, surface moist and shining. Asci ovoid, ellipsoid 1-4-spored, of variable dimensions [?were these oil droplets]. Some arthrospore formation. On alkaline agar, colonies whitish, humid suggesting bacterial colonies. No mycelium, asci 4-spored. In alkaline and neutral broth, turbidity, no pellicle, floccose deposit, yeast cells, ascospores 1-2 per ascus, no mycelium. In acid broth, gelified sediment and turbidity with yeast cells, pseudomycelium, and asci. Acid only, with glucose, sucrose, maltose, dextrin, no action with lactose, mannite, or fructose. No fermentation.

From the description, it seems quite likely that the large refringent oil globules of the older cells have been mistaken for ascospores and that this species as described by Froilano de Mello & Gonzaga Fernandes really belongs in *Parendomyces*.

Parendomyces communis (Castellani) Dodge, n. comb.

Monilia communis Castellani, Ann. Inst. Pasteur **30**: 152-153, 1916.

Broth and peptone water clear. Very slight acid formation and fermentation with fructose. Acid only with glucose, maltose, galactose, sucrose or dextrin. No action with others. Gelatin not liquefied.

Parendomyces enterocola (Macfie) Dodge, n. comb.

Monilia enterocola Macfie, Ann. Trop. Med. Parasitol. **15**: 275-279, 1921.

Myceloblastanon enterocola Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from feces of a patient suffering from persistent diarrhea accompanied by ascites and edema of the face, especially the left parotid area, the lumbar region, and the penis. Feces semifluid, pale canary yellow in color, frothy, containing numerous yeastlike cells. Grown on neutral-red lactose bile-salt agar.

Hyphae often predominate in liquid media, yeast forms on solid media with occasional branched, septate hyphae. Gram-positive, not acid-fast.

Colonies grow slowly, appear only after 48 hours. On glucose agar, growth abundant, white, cells somewhat elongate. Under anaerobic conditions growth somewhat slower. On potato, growth abundant and whitish, medium not stained. On gelatin, growth is slow. In broth and peptone water, whitish sediment but no pellicle is formed, medium remains clear. No fermentation or acid formation with glucose, fructose, maltose, or galactose. Gelatin not liquefied.

CASTELLANIA

Coloniis albidis, humidis, nitidis, pseudomycelio non bene evoluto vel morphologia ignota; gelatina non liquefacta; fermentatio adest.

The type species is *Monilia bronchialis* Castellani.

Colonies white, humid, usually shining, pseudomycelium not well developed, morphology unknown; gelatin not liquefied, sugars fermented.

After all the species of the imperfect filamentous yeasts have been distributed to existing genera as far as possible, one is confronted with many species which have been described without a sufficient characterization of their morphology. They have mostly been based on a minute description of their reaction with sugars and the coagulation of milk. They constitute the bulk of *Monilia* as described by Castellani & Chalmers (1913). While it is possible that some species have been included here which will be found to belong elsewhere, it is felt that they make a natural group. They are mostly saprophytic or weakly parasitic in lungs, mouth, and intestinal tract. It is with great pleasure that I dedicate this genus to Castellani, who has done so much work on this group.

There are a few species which differ from the greater portion of the genus in having a thin pellicle on broth. The position of this group of species is uncertain since they have strong resemblance to *Pseudomonilia,* but it has been thought best to place them here until more is known of their morphology, especially as they differ from *Pseudomonilia* by their fermentation of sugars.

Key to Species

- No pellicle on broth.
    - Only glucose fermented.
        - Not growing on ordinary media, colonies yellowish to brown, isolated from trachomatous tissue. *C. Nogami.*
        - Growing on ordinary media.
            - Colony yellowish or darker, brown floccose sediment in liquid media, from onychomycosis. *C. unguium.*
            - Colony white.
                - Ring or floating islets forming on liquid media, also sediment, from ulceromembranous stomatitis *C. Lesieuri.*
                - No ring or sediment in liquid media.
                    - Milk not coagulated, from sputum. *C. balcanica.*
                    - Milk coagulated. *C. parabalcanica.*
                    - Reaction with milk unknown, from thrush. *C. Metchnikoffi.*
            - Colony color unknown. *C. hominis.*
    - Glucose and fructose fermented.
        - Colony yellowish or brownish, lesions resembling furunculosis. *C. Castellanii.*
        - Colony white with center yellowish.
            - Center folded, from mouth. *C. dissocians.*
            - Center not folded, from skin. *C. epidermica.*

  - Colony white.
    - Ring on liquid media, from tear ducts of ass. *C. Mirandei.*
    - No ring on liquid media.
      - Milk coagulated. *C. Copellii.*
        C. londinensis.
      - Milk not coagulated.
        - Acid in maltose. *C. Negrii.*
        - Acid in galactose *C. intestinalis.*
- Glucose, fructose, and galactose fermented. *C. macedonensoides.*
- Glucose, fructose, and maltose fermented.
  - Milk coagulated.
    - No acid on other sugars. *C. Nabarroi.*
    - Acid on galactose, sucrose, and dextrin. *C. decolorans.*
  - Milk not coagulated.
    - On coagulated serum a brownish pigment which diffuses into the medium. *C. faecalis.*
    - On coagulated serum not forming a pigment. *C. bronchialis.*
- Glucose, fructose, maltose, and sucrose fermented.
  - Milk coagulated.
    - Curd digested. *C. Rogerii.*
    - Curd not digested. *C. aegyptiaca.*
  - Milk not coagulated.
    - Acid with raffinose. *C. pulmonalis.*
    - No acid with raffinose. *C. burgessi.*
- Glucose, fructose, maltose, and galactose fermented.
  - Milk coagulated.
    - Acid with sucrose.
      - Inulin fermented. *C. pseudometalondinensis.*
      - Dextrin fermented. *C. pseudolondinoides.*
  - Milk not coagulated.
    - Dextrin fermented.
      - Acid with pentoses, mannite fermented. *C. mannitofermentans.*
      - No acid with pentoses. *C. pseudolondinensis.*
    - Dextrin not fermented.
      - Raffinose fermented. *C. nivea.*
      - Raffinose not fermented. *C. metalondinensis.*
        C. Richmondi.
- Glucose, fructose and sucrose fermented.
  - Milk coagulated, clot digested. *C. Guilliermondi.*
  - Milk not coagulated.
    - No acidity on other sugars. *C. Muhira.*
    - Galactose acidified. *C. Guilliermondi.*
    - Maltose acidified. *C. Chalmersi.*
    - Maltose not acidified. *C. Lustigi.*
- Glucose, fructose, maltose, galactose, and sucrose fermented.
  - Milk coagulated. *C. metatropicalis.*
  - Milk not coagulated.
    - Dark pigment diffusing into serum medium, milk becoming alkaline. *C. insolita.*
    - Dark pigment not diffusing into medium, milk becoming acid. *C. tropicalis.*

Lactose fermented.	
Milk coagulated, colonies white.	
Sucrose fermented.	*C. Valeriana.*
Sucrose not fermented.	*C. pseudotropicalis.*
Reaction of milk unknown, colonies gray or even brown.	
Sucrose fermented.	*C. Kartulisi.*
Sucrose not fermented.	*C. Hashimotoi.*
Thin pellicle on broth.	
Glucose and fructose fermented.	
Milk not coagulated.	*C. linguae-pilosae.*
Milk coagulated.	
No acid on other sugars.	*C. parakrusei.*
Acid on other sugars.	*C. nitida.*
Glucose, fructose, and sucrose fermented.	*C. Orticoni.*
Glucose, fructose, and dextrin fermented.	*C. africana.*
Glucose and maltose fermented.	*C. platensis.*
Glucose, maltose, and galactose fermented.	
Sucrose not fermented.	*C. alba.*
Sucrose fermented.	
Slight or no fermentation with maltose.	*C. accraensis.*
Maltose fermented.	
Isolated from bronchomycosis.	*C. paratropicalis.*
Isolated from stools.	*C. enterica.*

Castellania Nogami Dodge, n. sp.

Cryptococcus sp. Ochi, Klin. Montatsbl. Augenheilk. **86**: 309-313, 1931; Nogami, *Ibid.* **86**: 313-316, 1931.

Isolated from trachomatous tissue in 19 out of 32 cases. Optimum temperature 22°-25° C. Grown on kojiserum agar. [This is made up of 3 parts "kojiwasser" and 1 part human serum with 3% agar. Kojiwasser is rice fermented by *Aspergillus oryzae*.] The organism may also be grown on a modified Loeffler medium. [This is made as follows: to horse meat broth containing 2% glucose or maltose and 1% glycerol, add horse or human serum, 1 part to 3 of the broth. Sterilize at 65° C. for 2 hours on each of 4 successive days, raising temperature on last day to 90° C. to produce semicoagulation.]

Colonies at first colorless, then white, yellowish, brownish to reddish, and, finally, dark brown. Colonies hard, deep hyphae thicker in Loeffler than in koji medium. On koji serum agar, colonies more superficial, mycelium less abundant, spores slightly smaller. Growth either aerobic or anaerobic. Glucose fermented. Gelatin not liquefied.

Castellania unguium (Bourgeois) Dodge, n. comb.

Saccharomyces unguium Bourgeois, Derm. Zeitschr. **22**: 411-420, 1915.

Found in cases of onychomycosis of the hands with nails yellowing and breaking, causing some pain. It is not virulent for animals. Intraperitoneal injection results in the formation of grayish white nodules in the liver from which the organism may easily be recovered.

Cells 2-5 × 1-3μ, solitary or in chains of 3-4 cells. Branched hyphae appear in old liquid cultures.

Colonies flat or hemispheric, ivory white on neutral agar, yellowish on maltose agar, dirty grayish red on potato, becoming flattened, convex, 1 cm. in diameter. On glycerol or glucose agar, colony smooth or finely folded, bright brown to whitish. On gelatin, growth along stab is slow but surface growth is abundant. In beef and maltose broth, there is a brown floccose sediment but no cloudiness. Glucose fermented. Litmus milk turns alkaline.

Castellania Lesieuri (Beauverie) Dodge, n. comb.

Cryptococcus Lesieuri Beauverie, Jour. Physiol. Path. Gén. **14**: 994-996, 1912.

Cryptococcus Lesieurii Castellani & Chalmers, Man. Trop. Med. ed. 2, 771, 1913.

Isolated in a case of ulceromembranous stomatitis in a young woman with typhoid. Not pathogenic for experimental animals.

After 4 days on malt agar at 26° C., cells are ovoid, 2-3μ, becoming 8×3 or $12 \times 2\mu$, although mostly $5 \times 2\mu$. Both sprouting forms and hyphae present. No spores formed on plaster blocks.

On malt agar, growth cream white, surface finely folded, vermiculate to the edge. On potato at 26° C., growth is less rapid and less abundant, dirty white, the upper part appearing dry, pulverulent and chalky white. On carrot, after 3 days at the same temperature, development is abundant, white with the surface viscid and brilliant, formed of small connivent mounds. Growth on malt gelatin, at the laboratory temperature of 15°-18° C., is the same as on the agar. In malt extract, after 9 hours a ring and islets appear, a light sediment in 3 days with white ring well developed. Islets white and dry, 0.5-1.5 mm. in diameter. In carrot juice, development is rapid. After 8-9 hours the surface is covered with small, white islets, smaller than in malt, about 0.5 mm. in diameter. No ring forms although a few of these islets are drawn up onto the sides by capillarity. Sediment present. In Raulin's liquid, development is slow, a sediment appearing in 4 days. Glucose fermented, not fructose, sucrose, maltose, or levulose. Gelatin not liquefied.

Castellania balcanica (Castellani & Chalmers) Dodge, n. comb.

Monilia balcanica Castellani & Chalmers, Man. Trop. Med. ed. 3, 1090, 1919.

Myceloblastanon balcanicum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Found in sputum. Hoffstadt & Lingenfelter (1929) describe in detail a case of pulmonary infection due to this organism. They found it pathogenic for rabbits.

Cells $4 \times 7\mu$. Hyphae composed of chains up to 6 cells.

Hoffstadt & Lingenfelter give cultural characters of their strain which had no action on fructose. Organism originally described as fermenting glucose only, with a slight acid formation in fructose and arabinose (due, perhaps, to impurities in the sugars).

Castellania parabalcanica (Castellani & Chalmers) Dodge, n. comb.

Monilia parabalcanica Castellani & Chalmers, Man. Trop. Med. ed. 3. 1090, 1919.

Myceloblastanon parabalcanicum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Glucose only fermented, with acid formation. Milk coagulated.

Castellania Metchnikoffi (Castellani) Dodge, n. comb.

Monilia Metchnikoffi Castellani, Ann. Inst. Pasteur **30**: 149-154, 1916.

Isolated from a case of thrush in London.

Peptone broth remains clear. Acid formation and fermentation with glucose, slight with fructose and maltose. Slight acid formation with galactose. Neither coagulated serum nor gelatin liquefied.

Castellania hominis (Castellani & Chalmers) Dodge, n. comb.

Saccharomyces sp. Klein & Gordon, Centralbl. Bakt. I, **35**: 138, 139, 1904.

Saccharomyces hominis Castellani & Chalmers, Man. Trop. Med. ed. 2, 769, 1913. Not Busse, 1895.

Isolated as a contamination during an epidemic of tonsillitis which resembled diphtheria. Not pathogenic to rabbit and guinea pig.

Yeast cells spherical or ovoid, 5-7 × 1-3μ, with pseudomycelium formed only in media containing glucose.

On sugar media, colonies red, round, margins pellucid. On sugar broth, sediment but no ring or pellicle. On milk, red pellicle curd slowly digested. Glucose not fermented. Gelatin slowly liquefied.

Castellania Castellanii (Re) Dodge, n. comb.

Cryptococcus sp. Castellani, Jour. Trop. Med. Hyg. **27**: 326-328, *2 figs.*, 1924.

Monilia sp. Castellani, Jour. Trop. Med. Hyg. **28**: 317-319, 1925.

Monilia Castellanii Re. Jour. Trop. Med. Hyg. **28**: 217-223, 1925.

Cryptococcus Castellanii Castellani, Am. Jour. Trop. Med. **8**: 390-392, 1929; Mallardo, Jour. Trop. Med. Hyg. **32**: 145-147, 1929.

Torulopsis Castellanii Castellani & Jacono, Jour. Trop. Med. Hyg. **36**: 312-313, *Figs. 38-39,* 1933.

Isolated from atypical cases of furunculosis not affected by staphylococcus vaccine.

Cells gram-positive, not acid-fast, spherical 3-4μ in diameter, occasionally a few hyphae on liquid media. No ascospores.

Colony white then yellowish or brownish on glucose agar, similar with a reddish or purplish tinge on potato. No fermentation when first isolated, but after a few transplants ferments glucose and fructose; also produces slight acidity in galactose. Milk not affected. Gelatin and serum not liquefied.

Castellania dissocians (Mattlet) Dodge, n. comb.

Monilia dissocians Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 24-25, 1926.

Isolated from a grayish white coating of the base of the tongue in a native of the Belgian Congo. In one case the tonsils and pharynx were also involved. Microscopic examination of scrapings showed filaments 1.5-2 × 6-8μ. Treatment with $KI.I_2$ in glycerol cured the lesions slowly.

After 3 days in potato water at 37° C. this shows a large variety of forms between the spherical cell and the hyphal form. Long cells about 20 × 2μ, occasionally separated by spherical cells. By the thirtieth day these long-celled filaments are much like those of *Castellania Muhira.* No chlamydospores.

On Sabouraud agar, at 37° C., culture dull, white, circular. Later the center yellows with radial striations, margin lobed with hyphal tufts penetrating the medium. On gelatin stab, appearance of inverted fir tree. In potato decoction, white flaky sediment, no pellicle. Fermentation with glucose and fructose, no fermentation of maltose, galactose, sucrose, lactose, mannite, dextrin, or inulin. Litmus milk slightly acid. Gelatin not liquefied.

Castellania epidermica (Ciferri & Alfonseca) Dodge, n. comb.

Blastodendrion intestinale var. *epidermicum* Ciferri & Alfonseca, Centralbl. Bakt. II, **83**: 273-276, *1 pl.,* 1931.

Isolated from a cutaneous mycosis of the face.

Cells spherical in the center of the colony and on unfavorable media, 5μ in diameter, occasionally 6 × 4μ, giant cells 7-8μ. Somewhat branched pseudomycelium at the margins of the colony, cells elongate in short chains with thick cell walls (1-1.5μ). On liquid media up to 20 cells in chains. No ascospores.

Optimum temperature 36°-38° C. On Sabouraud agar (pH 6.2), colony white then yellowish, dense, creamy, thick, opaque with porcelain luster in refracted light, later almost cloudy, center level and uniform, margins thinner and grossly lobate, sometimes plumelike; obscurely zonate in old cultures. On grape must gelatin (pH 5.6), similar but more zonate. On Difco malt agar (pH 6.8), similar, but growth more abundant and irregular. On Difco prune agar (pH 6.8), growth poor, transparent, zones not evident, margins irregular but nearly continuous. On potato and carrot, colony irregular, indefinite, spreading, growth rapid. On corn meal agar (pH 7.2), surface very brilliant. On Gorodkova agar (pH 6.8), growth poor, colonies small, almost transparent, later whitish and opaque. On peptone glucose broth (pH 6.4), growth poor, no pellicle, slight ring, sediment hyaline, agglomerated, grayish white, viscous, liquid darkens and thickens. On autolyzed yeast (pH 6.4) and malt solution (pH 6.0), growth very poor, no ring or pellicle, little sediment. Giant colony of Will's type I, no crater, periphery thin, transparent, slightly denticulate, odor of fermentation. No inversion of sugars, ferments glucose, fructose, trehalose, assimilates glucose, fructose, maltose, and sucrose, no assimilation of organic acids. Gelatin not liquefied.

Castellania Mirandei (Velu) Dodge, n. comb.

Cryptococcus Mirandei Velu, Bull. Soc. Path. Exot. **17**: 545-547, 1924.

Torulopsis Mirandei Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Cryptococcus lacrymeatus Jeaume, Blastomycose des voies lacrymales de l'âne au Maroc. Thèse Doc. Vét. Avignon, 1926.

Found in tear ducts only. Differs from *Zymonema farciminosum* in specificity for ass. Causes a pseudoinflammatory tumor characterized by a lymphocyte and plasmatic infiltration without gigantocellular reaction, vascularization, or sclerosis.

Obtained in pure culture on 5% citric acid agar. Grows well on Sabouraud agar. Growth poor on potato and potato glycerol. On acid potato, colonies thick, creamy, confluent. Growth on carrot similar to that on acid potato but less. On beet, still less. Organism will grow in 1.5% NaOH glycerol peptone. In liquid media, there is abundant growth at bottom. In malt extract, a ring in 48 hours. In prune decoction, broth, or liver broth, Hayen, Hansen, or Cohn's solutions, growth is good; in carrot decoction, poor. Also poor in Pasteur, Laurent, or Nägeli's solutions. Glucose and fructose fermented. Lactose, galactose, mannitol, sucrose, and maltose not fermented. Gelatin not liquefied.

Castellania londinensis (Castellani & Chalmers) Dodge, n. comb.

Monilia londinensis, Castellani & Chalmers, Man. Trop. Med. ed. 3, 1084, 1919.

Myceloblastanon londinense Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from a case of thrush, also found in the vagina.

Colony white. Acid formation and fermentation with glucose and fructose; acid only with maltose, galactose, sucrose, and lactose. Milk acidified and clotted.

Castellania Copellii (Neveu-Lemaire) Dodge, n. comb.

Cryptococcus sp. Copelli, Giorn. Ital. Mal. Ven. Pelle **46**: 467-492, *2 pls.*, 1912.

Cryptococcus Copellii Neveu-Lemaire, Précis Parasitol. Hum. 79, 1921; Ota, Ann. Parasitol. Hum. Comp. **2**: 51-53, *Fig. 6*, 1924.

Hefe Copelli Sasakawa, Centralbl. Bakt. I, **88**: 269-285, *1 pl.*, 1924.

Myceloblastanon Copellii Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Torulopsis Copellii Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Referred to *Cryptococcus Breweri* by Vuillemin, Champ. Parasit. Homme Anim. 96, 1931.

Isolated from lesions on the tongue. Pathogenic to rabbits and guinea pigs.

Cells spherical, sparingly allantoid, 5-12μ in diameter in tissues, 3-16μ in cultures. Elongate cells in older cultures. Beginnings of hyphal formation was observed on certain media, but they were not studied long enough to obtain spores. Optimum temperature for growth 33°-38° C.; no growth at 42°-45° C.

Colonies small, white, rounded, elevated at center. On Sabouraud agar, colony circular, crateriform, yellowish white, moist, opaque. On potato, colony thick, an elevated plateau, with margins coarsely festooned, opaque, velvety. On beet, colony similar but rose color. On gelatin, colony shining, glassy white, round, elevated, margin regular. Growth strictly aerobic. On coagulated serum, colony thin, dry, powdery. On liquid media, no pellicle, slight turbidity, abundant sediment of tiny white flocci (glucose, mannite, maltose-peptone, wine, milk, Raulin's solution). Growth on urine or on horse or rabbit broth shows no pellicle or turbidity but small white flocci. No indol formation on peptone. Glucose and fructose fermented. Milk coagulated in 10-15 days. Gelatin not liquefied.

Castellania Negrii (Castellani) Dodge, n. comb.

Endomyces Negrii Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia Negrii Castellani & Chalmers, Man. Trop. Med. ed. 2, 822, 1913.

Thin pellicle on broth (denied by Castellani & Chalmers, Man. Trop. Med. ed. 3, 1919). Acid and fermentation with glucose and fructose, slight with galactose, sucrose (1913, not 1919), and raffinose (1913, not 1919). Acid only with maltose, sucrose (1919), and lactose; slight with mannite and raffinose (1919).

Castellania intestinalis (Castellani) Dodge, n. comb.

Endomyces intestinalis Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia intestinalis Castellani & Chalmers, Man. Trop. Med. ed. 2, 827, 1913.

Myceloblastanon intestinale. Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from stools and saliva.

Acid formation and fermentation with glucose and fructose; slightly acid with maltose; acid with galactose and sucrose. Litmus milk first acidified, then decolorized.

Castellania macedonensoides (Castellani & Taylor) Dodge, n. comb.

Monilia macedonensoides Castellani & Taylor, Jour. Trop. Med. Hyg. **28**: 244, 1925; Castellani, Douglas & Thompson, Jour. Trop. Med. Hyg. **28**: 258, 1925.

Found in vagina? Or bronchomycosis fide Zepponi, 1931.

Morphology close to that of *M. tropicalis* fide Zepponi, 1931. Fermentation of monosaccharides as in *M. tropicalis,* slight acidification with maltose and potato starch, decoloration of pea starch.

Castellania Nabarroi (Castellani & Chalmers) Dodge, n. comb.

Monilia Nabarroi Castellani & Chalmers, Man. Trop. Med. ed. 3, 1090, 1919.

Myceloblastanon Nabarroi Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from sputum.

Colony white. Fermentation of glucose, fructose, and maltose. Milk coagulated. Gelatin not liquefied.

Castellania decolorans (Castellani & Low) Dodge, n. comb.

Monilia decolorans, Castellani & Low, Jour. Trop. Med. Hyg. **16**: 33-35, 1913.

Myceloblastanon decolorans Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from scrapings of the tongue in sprue.

Growth abundant, slightly acid on solid sugar media, colonies creamy white with smooth surface. Yeastlike forms with some hyphae in water of condensation. Poor growth in alkaline media, fairly good growth on gelatin. Acid and fermentation with glucose, fructose, and maltose. Acid only with galactose, sucrose, and dextrin.

Castellania faecalis (Castellani) Dodge, n. comb.

Endomyces faecalis Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia faecalis Castellani, Jour. Trop. Med. Hyg. **17**: 307, 1914.

Myceloblastanon faecale Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from feces.

On coagulated serum, growth forms a brownish pigment which diffuses into the medium. Acid and fermentation with glucose, fructose, and maltose, slightly acid and fermentation with galactose and sucrose. Litmus milk turns acid, then is decolorized and slightly digested. Neither coagulated serum nor gelatin liquefied.

Castellania bronchialis (Castellani) Dodge, n. comb.

Endomyces bronchialis Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Myceloblastanon bronchiale Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida bronchialis Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Isolated from sputum. Probably the organism of Smith & Sano (1933) from a case showing meningeal involvement should be referred here.

Colonies white. Acid formation and fermentation with glucose, fructose, and maltose, slight with sucrose. Acid only with dextrin. No action on milk, coagulated serum, or gelatin.

Castellania aegyptiaca (Khouri) Dodge, n. comb.

Monilia aegyptiaca Khouri, Bull. Soc. Path. Exot. **26**: 7-9, 1933.

Isolated from sputum mixed with blood from case of pulmonary blastomycosis. No trace of *Mycobacterium tuberculosis,* no blood parasites, Wassermann reaction negative. Organism slightly pathogenic for guinea pig.

Spherical or ovoid cells with occasional hyphae observed in the sputum. Long hyphae with elongate-ovoid blastospores in cultures. No ascospores.

On Sabouraud agar, colony creamy white, confluent, cells 3-8 average 5μ in diameter, rarely sprouting. Optimum temperature 36°-37° C. Cells gram-positive. On carrot and potato, colonies creamy white. On liquid media, no pellicle, floccose sediment, no pigment. Litmus milk acidified, coagulated slowly after seventh day and curd slowly digested. Glucose, fructose, maltose, and sucrose fermented and acidified; galactose and raffinose also acidified. Neutral red reduced. Serum and gelatin not liquefied.

Castellania Rogerii (Sartory & Demanche) Dodge, n. comb.

Cryptococcus sp. Demanche & Sartory, C. R. Soc. Biol. **63**: 261-262, 1907.

Cryptococcus Rogerii Sartory & Demanche, Bull. Soc. Myc. France **23**: 179-185, 1907.

Torulopsis Rogerii Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from pus in a case of peritonitis following perforation of the stomach.

Cells elongate, 8-10 × 2-3μ, sprouting. Pseudomycelium present. No spores. Optimum temperature for growth 30°-35° C., no growth over 41° C.

Sucrose inverted. Maltose fermented, no action on galactose or lactose. Milk coagulated in 5 days, curd not digested.

C. Rogerii var. (?), Beauverie & Lesieur, Jour. Phys. Path. Gén. **14**: 992-994, 1912, from pharyngeal exudate in case of typhoid, differs only in being nonpathogenic to rabbit. Strain IV of Spiethoff (1904), isolated from diabetic urine may belong here, but was nonpathogenic to laboratory animals.

Castellania pulmonalis (Castellani) Dodge, n. comb.

Endomyces pulmonalis Castellani, Arch. de Parasitol. **16**: 184-186, 1913.

Monilia pulmonalis Castellani & Chalmers, Man. Trop. Med. ed. 2, 828, 1913.

Candida pulmonalis Basgal, Contr. Estudo Blastomycoses Pulmonares 49, 1931.

Isolated from sputum and samples of tea.

Thin pellicle formed on broth, brown pigment on coagulated serum. Acid formation and fermentation with glucose, fructose, maltose, sucrose, slight with galactose and arabinose, acid only with raffinose, very slight with mannite.

Castellania burgessi (Castellani) Dodge, n. comb.

Endomyces burgessi Castellani, Arch. de Parasitol. **16**: 184-186, 1913.

Monilia burgessi Castellani & Chalmers, Man. Trop. Med. ed. 2, 828, 1913.

Isolated from the air.

Colonies generally white and creamy, but black or brown pigment produced on serum. Slight acid formation and fermentation with glucose, maltose, sucrose, acid only with fructose and galactose, no action on other sugars. No action on milk, serum, or gelatin.

Castellania mannitofermentans (Castellani) Dodge, n. comb.

Monilia mannitofermentans Castellani, Proc. Soc. Exp. Biol. Med. **26**: 544-545, 1929.

Isolated from sputum in a case of chronic bronchitis.

Gram-positive, acid-fast negative. Acid and fermentation with glucose, galactose, maltose, fructose, mannitol, and dextrin. Acid only with arabinose and xylose.

Castellania pseudolondinensis (Castellani & Chalmers) Dodge, n. comb.

Monilia pseudolondinensis Castellani & Chalmers, Man. Trop. Med. ed. 3, 1082, 1919.

Isolated from sputum.

Acid formation and fermentation of glucose, fructose, maltose, galactose, and dextrin. Litmus milk not clotted.

Castellania pseudolondinoides (Castellani & Chalmers) Dodge, n. comb.

Monilia pseudolondinoides Castellani & Chalmers, Man. Trop. Med. ed. 3, 1082, 1919.

Differs from *C. pseudolondinensis* only in clotting litmus milk. Acid and fermentation with glucose, fructose, maltose, galactose, and dextrin.

Castellania pseudometalondinensis (Castellani & Chalmers) Dodge, n. comb.

Monilia pseudometalondinensis Castellani & Chalmers, Man. Trop. Med. ed. 3, 1082, 1919.

Acid and fermentation with glucose, fructose, maltose, galactose, and inulin. Litmus milk clotted.

Castellania nivea (Castellani) Dodge, n. comb.

Endomyces niveus Castellani, Lancet **1**: 15, 1912; Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia nivea Castellani & Chalmers, Man. Trop. Med. ed. 2, 826, 1913.

Myceloblastanon niveum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida nivea Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Reported to cause bronchomycosis, but isolated from sputum not collected in a sterile vessel, and therefore of doubtful pathogenicity.

Acid formation and fermentation with glucose, fructose, maltose, galactose, and raffinose, slight with sucrose.

Castellania metalondinensis (Castellani & Chalmers) Dodge, n. comb.

Monilia metalondinensis Castellani & Chalmers, Man. Trop. Med. ed. 3, 1082, 1919.

Myceloblastanon metalondinense Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida metalondinensis Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Isolated in cases of thrush and from vaginal discharge. Spaar reports this organism in hard, milky growth on palate which was cured by a potassium chlorate mouth wash.

On plain agar and glucose agar, growth is abundant and creamy white. Growth on gelatin fairly abundant, scanty on serum. Fermentation and acid formation with glucose, fructose, maltose, galactose; none with other sugars. Litmus milk unchanged or slightly acid, no gas evolved. Neither coagulated serum nor gelatin liquefied.

Castellania Richmondi (Shaw) Dodge, n. comb.

Monilia Richmondi Shaw, Sci. **64**: 300, 1926.

From a case of clinical tuberculosis, with small hard whitish granules in the sputum. Pathogenic to guinea pigs intravenously but not intraperitoneally, pathogenic to rabbits intraperitoneally.

Colonies on dextrose agar, creamy white with a smooth surface, of yeast-like cells. In dextrose broth, both budding forms and mycelium. No pellicle on broth. Milk alkaline in 48 hours. Acid and fermentation with glucose, fructose, maltose, and galactose. No acid or fermentation with sucrose, lactose, mannite, dulcite, raffinose, arabinose, adonite, dextrin, sorbite, or inulin. Neither gelatin nor coagulated serum liquefied. No indol produced.

Castellania pseudoguillermondi (Castellani & Chalmers) Dodge, n. comb.

Monilia pseudoguillermondi Castellani & Chalmers, Man. Trop. Med. ed. 3, 1082, 1919.

Isolated from sputum.

Acid formation and fermentation with glucose, fructose, and sucrose. Milk clotted and digested. Gelatin not liquefied.

Castellania Muhira (Mattlet) Dodge, n. comb.

Monilia Muhira Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 23-24, 1926.

Isolated from scrapings of a grayish coating of tongue which caused pain in swallowing and slight elevation of temperature each night. Patient a soldier in Belgian Congo. Treatment with glycerol $KI.I_2$ brought about complete cure.

In scrapings, spherical or ovoid cells, 2-3μ, some sprouting. Growth for 3 days in potato decoction at 37° C., only spherical cells and elongate cells, occasionally arranged end to end, with either spherical or elongate cells at the articulations. Spherical cells 6-7μ in diameter, elongate cells 12 × 2.5μ. Typical hyphae to be seen in depths of gelatin cultures. These are formed of cells about 20 × 2-2.5μ, spherical or ovoid blastospores or other hyphae at the septa. Free ends of the cells are rounded. Protoplasm of long cells is reduced to a thin layer along the wall. No chlamydospores observed. Optimum temperature 37° C.

On Sabouraud agar at 37°, the culture is dull, white, rounded. Later the center yellows with radial striations, margin lobed with outgrowths of large, contorted hyphae, extending down into medium. On gelatin stab, culture white, margin indented at surface. Horizontal hyphae grow out into depth of medium, giving a growth of inverted cone shape. On potato decoction, sediment of small white flakes. Ferments glucose, fructose, sucrose, not maltose, galactose, lactose, mannite, dextrin, or inulin. No acid or coagulation with milk. Gelatin not liquefied.

Perhaps this species should be referred to *Blastodendrion,* near *B. Kayongosi.*

Castellania Guilliermondi (Castellani) Dodge, n. comb.

Endomyces Guilliermondi Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia Guilliermondi Castellani & Chalmers, Man. Trop. Med. ed. 2, 826, 1913.

Myceloblastanon Guilliermondi Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from sputum in case of bronchomycosis.

Thin pellicle on broth. Acid formation and fermentation with glucose, fructose, sucrose, slight with raffinose. Galactose becomes acid, maltose, slightly acid. Coagulated serum and gelatin not liquefied. Action on milk uncertain, some reporting coagulation which Aichelburg denies.

Castellania Chalmersi (Castellani) Dodge, n. comb.

Endomyces paratropicalis D Castellani, Centralbl. Bakt. I, **58**: 236-238, 1911.

Monilia Chalmersi Castellani & Chalmers, Man. Trop. Med. ed. 2, 826, 1913.

Endomyces Chalmersi Castellani, Arch. de Parasitol. **16**: 184-186, 1913.

Myceloblastanon Chalmersi Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida Chalmersi Basgal, Contr. Estudo Blastomycoses Pulmonares 49, 1931.

Isolated in case of bronchitis.

Colonies white. Acid formation and fermentation with glucose, fructose, and sucrose, slight with galactose and inulin. Slight acid formation only with maltose and raffinose. Milk turned slightly acid, then alkaline. Neither coagulated serum nor gelatin liquefied.

Castellania Lustigi (Castellani & Chalmers) Dodge, n. comb.

Monilia Lustigi Castellani & Chalmers, Man. Trop. Med. ed. 2, 828, 829, 1913.

Isolated from samples of tea.

Colonies snow white. On coagulated serum, a black pigment diffuses into the medium. Litmus milk slightly acid then decolorized. Slight acid formation and fermentation with fructose, sucrose, raffinose. Acid with glucose, galactose, and dextrin, very slight with maltose. No liquefaction of coagulated serum or gelatin.

Castellania metatropicalis (Castellani & Chalmers) Dodge, n. comb.

Monilia metatropicalis Castellani & Chalmers, Man. Trop. Med. ed. 3, 1087, 1919.

White colony on glucose agar. Acid formation and fermentation with glucose, fructose, maltose, galactose, and sucrose. Milk coagulated.

Castellania insolita (Castellani) Dodge, n. comb.

Endomyces insolitus Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia insolita Castellani & Chalmers, Man. Trop. Med. ed. 2, 827, 1913.

Myceloblastanon insolitum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida insolita Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Isolated from feces and saliva.

In culture, forms a dark pigment which diffuses into the medium. Acid formation and fermentation with glucose, fructose, maltose, galactose, sucrose. Slightly acid with mannite. Milk turns slightly acid, then alkaline. No liquefaction of coagulated serum or gelatin.

Castellania tropicalis (Castellani) Dodge, n. comb.

Oidium tropicale Castellani, Philippine Jour. Sci. B **5**: 197-202, 1910; Brit. Med. Jour. 1910 **2**: 686-689, 1910.

Endomyces tropicalis Castellani, Centralbl. Bakt. I, **58**: 236-238, 1911.

Monilia tropicalis Castellani & Chalmers, Man. Trop. Med. ed. 2, 824-825, 1913.

Atelosaccharomyces tropicalis Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 263-268, 1918.

Myceloblastanon tropicale Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida tropicalis Basgal, Contr. Estudo Blastomycoses Pulmonares 49, 1931.

Isolated from sputum in 4 cases of coughing, 2 of the patients having been exposed to tea dust. Three cured by medication with potassium iodide. Tuberculosis absent. Later same organism isolated in cases of tonsillomycoses and thrush.

Mycelium 3-4μ in diameter, bearing 4 shorter cells at either end. Blastospores ovoid or spherical 4-8μ in diameter. Gram-positive.

Growth on agars abundant, thick, roundish, creamy, white. Acid formation and fermentation with glucose, fructose, maltose. In the cases derived from tea dust, galactose and sucrose also fermented. No action on milk.

Colonies large, elevated, round, creamy, white, cells spherical, Gram-positive, not acid-fast. Mycelium formed in peptone water. Acid formation and fermentation with glucose, maltose, and sucrose in 24 hours, with galactose and fructose in 5-6 days—Reimann, 1931.

Zepponi (1931) reports fermentation and acidification with xylose, slight acidity with arabinose, no change in alcohols, polysaccharides or glucosides of hydroaromatic compounds.

Castellania macedonensis (Castellani & Chalmers) Dodge, n. comb.

Monilia macedonensis Castellani & Chalmers, Man. Trop. Med. ed. 3, 1087, 1919.

Myceloblastanon macedonense Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Found in sputum.

Colony thick, creamy, whitish, cells ovoid to spherical, solitary or in chains, 3-6μ in diameter, gram-positive. Sediment produced in broth, no turbidity. [Sanfilippo 1924.]

Acid formation and fermentation of glucose, fructose, galactose, sucrose, and inulin. Milk coagulated. Gelatin and serum not liquefied.

Castellania Valeriana Dodge, n. sp.

Oidium albicans var. Galli-Valerio, Arch. de Parasitol. **1**: 572-582, *13 figs.,* 1898.

Isolated from stools of infant suffering from chronic gasteroenteritis. Virulence slight for laboratory animals but is augmented when inoculated along with *Bacterium coli.*

Mycelium on ascitic gelatin with terminal chlamydospores after one month.

On agar, colonies white, shining, pinhead size. On maltose, growth yellowish white and of a yeasty odor. On gelatin, small, subspheric, white colonies with small, granular colonies along stab. Glucose, maltose, and lactose fermented. Milk coagulated in 5 days and coagulum digested in 3 months. Gelatin not liquefied.

Castellania pseudotropicalis (Castellani) Dodge, n. comb.

Endomyces pseudotropicalis Castellani, Centralbl. Bakt. I, **58**: 236-238, 1910.

Monilia pseudotropicalis Castellani & Chalmers, Man. Trop. Med. ed. 2, 825, 1913.

Atelosaccharomyces pseudotropicalis Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 264, 268, 1918.

Myceloblastanon pseudotropicalis Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida pseudotropicalis Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Four numbered strains producing bronchomycosis were described by Castellani, Practitioner **124**: 69, 1930.

Acid formation and fermentation of glucose, fructose, sucrose, lactose; slight acid formation and fermentation with galactose. Milk coagulated. Gelatin not liquefied.

Castellania Kartulisi (Castellani) Dodge, n. comb.

"Saccharomyzetaceen" Kartulis, Zeitschr. Hyg. **64**: 285-304, 1909.

Levure de Kartulis Sasakawa, Centralbl. Bakt. I, **88**: 272, 1922; Ota, Ann. Parasitol. Hum. Comp. **2**: 55-57, *Fig. 11,* 1924.

Cryptococcus Kartulisi Castellani, Am. Jour. Trop. Med. **8**: 413, 1928.

Myceloblastanon Kartulis Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from chronic fistulas of gluteal region in one hundred cases, all men, mostly Egyptians between forty and sixty, in Alexandria. Three stages of growth observed; knot formation, softening of knots, fistula formation. Pathogenicity to gray mice, rabbits, and guinea pigs unproved.

Cells ovoid and allantoid or longer, up to 18μ in diameter, in chains. Spores (?) 3-4 per ascus, 10μ in diameter. Allantoid cells have enlarged ends (with 12 spores?). Chlamydospores in old cultures. Figures of spores not convincing, although author asserts that they differ from oil droplets.

Growth good on sugar agar and potato, not so good on glycerol and peptone agar. Colonies on potato, white to ash-gray, shining. In beef broth there appears a slimy sediment, but no surface growth. Glucose and lactose slowly fermented, sucrose rapidly, with the formation of large bubbles of gas.

Castellania Hashimotoi, Dodge, n. sp.

Hefe Hashimoto, Jap. Zeitschr. Derm. Urol. **22**: 1-34, *Pl. 1* [1-2], 1922.

Lesions on the face in front of the ear (2 cases). Pathogenic for mice and guinea pigs.

Yeast cells spherical or ovoid on solid media, more elongate in the pellicle of malt extract. Endospores appear in 20 hours on gypsum block at 22° C. Optimum 23°-25° C.

Colonies gray white at first, becoming grayish yellow or brownish with shining surface and elevated border, with radiating margins. Fermentation of lactose, maltose, glucose, not sucrose and galactose.

The figures are so poorly reproduced that they give little information, but one is inclined to doubt the presence of true ascospores.

Castellania linguae-pilosae (Lucet) Dodge, n. comb.

Saccharomyces linguae-pilosae Lucet, Arch. de Parasitol. **4**: 262-287, 1901.

Cryptococcus linguae-pilosae Castellani & Chalmers, Man. Trop. Med. ed. 2, 770, 1913.

Monilia sp. Catanei, Arch. Inst. Pasteur Algérie **3**: 386-388, 1925.

Myceloblastanon linguae-pilosae Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Torulopsis linguae-pilosae Almeida, Annaes Fac. Med São Paulo **9**: 10, 1933.

Isolated from black pilose tongue with hypertrophy of papillae and dark discoloration.

Pathogenic for mice but not for larger laboratory animals except by injection, which reproduced lesion on tongue of rabbit.

Cells spherical, 4-8μ in diameter, or elongate, 12-17 × 6μ, sometimes forming chains of up to 10 cells. Spores perhaps present, but not definitely demonstrated. Guéguen reports that, in old cultures, cells are 4-5μ in diameter, with small ovoid protrusions attached to the mother cell by fine pedicels. Some cells have no more than 4-5 such protrusions, while the remainder of the cell content divides into 5 or 6 unequal masses grouped at the periphery, each mass surrounded by its own wall. Best growth at 25°-35° C., growth slow above 40° C., ceases at 42° C.

On glucose agar, Sabouraud agar, or glucose gelatin, growth white, creamy, shining, or slightly dull, tomentose. Colonies on potato thin, yellowish, brown, dry, dull, potato finally assuming same color as culture; on potato glycerol, creamy, growth better; on carrot, colonies small, punctiform, white. On gelatin, small yellowish white colonies with arborizations in stabs. Growth slow on meat broths in the absence of glycerol or glucose, very good in malt extract, juice of apples, pears, or grapes, with slight pellicle and ring and a turbidity which settles, leaving a thickened gray pellicle and sediment. Glucose, fructose, galactose, maltose, sucrose, and dextrin fermented. No action with mannite or lactose. No action on milk. Gelatin and coagulated serum not liquefied.

Castellania parakrusei (Castellani & Chalmers) Dodge, n. comb.

Monilia parakrusei Castellani & Chalmers, Man. Trop. Med. ed. 2, 810, 1913.

Myceloblastanon parakrusei Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from sputum.

Acid and fermentation with glucose and fructose. No action on other sugars. Milk coagulated. Pellicle on broth.

Castellania nitida (Castellani) Dodge, n. comb.

Endomyces pseudotropicalis C Castellani, Centralbl. Bakt. I, **58**: 236-238, 1911, non al.

Endomyces nitidus Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia nitida Castellani & Chalmers, Man. Trop. Med. ed. 2, 826, 1913.

Myceloblastanon nitidum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida nitida Basgal, Contr. Estudo Blastomycoses Pulmonares, 50, 1931.

Isolated from sputum in case of bronchomycosis.

Colony white, shining, thin pellicle on broth. Acid and fermentation with glucose and fructose; acid only with maltose, galactose, sucrose, lactose, mannite; slight acid with dextrin and raffinose. Milk coagulated.

Castellania Orticoni Dodge, n. sp.

Cryptococcus sp. Sartory & Orticoni, Rev. Path. Comp. **14**: 174-176, 1914.

Isolated from grayish superficial lesions in the mouth. Pathogenic to rabbit and guinea pig.

Cells ovoid, 5-11 × 4μ, sprouting. Optimum temperature for growth on carrot 22°-30° C., no growth above 39° C. On peptoglycerol broth, optimum temperature is 26°-28° C.

On peptoglycerol broth, pellicle is formed with pseudomycelium and a sediment of spherical or ovoid cells. No ascospores seen on gypsum block. Sucrose inverted. Glucose and fructose fermented, but not maltose, lactose, or galactose. Almost no growth and no action on coagulated serum. Gelatin not liquefied.

Castellania africana (Macfie) Dodge, n. comb.

Monilia africana Macfie, Ann. Trop. Med. Parasitol. **15**: 275-277, 1921.

Isolated from feces in a case of obstinate diarrhea. Patient's tongue red, irregularly fissured, indented by teeth and partly eroded. Throat red. Feces canary yellow and frothy. *Castellania* abundant, *Entamoeba coli* and *Blastocystis enterocola* also present.

Cells ovoid and somewhat elongate, 4.5 × 1.6μ [average of measurements of 10 cells]. On solid media, yeastlike cells predominate with a few branched, septate hyphae. In liquid media, hyphae most common. Gram-positive. Not acid-fast.

On glucose agar, after 24 hours, white, very fluid growth with dull, pellicle-like surface. Growth slower and less abundant under anaerobic conditions. On potato, growth is dull and white with a whitish efflorescence appearing later. In broth and peptone water, sediment whitish, medium clear. Surface pellicle in broth only. Glucose, fructose, and dextrin fermented. Gelatin not liquefied.

Castellania platensis (Peruchena) Dodge, n. comb.

Monilia platensis Peruchena, Semana Méd. **36**: [1-31] *10 figs.*, 1929.

Isolated from a patient who suffered from cough, expectoration, loss of strength and weight. Lung involved. Pathogenic for rabbits.

Yeast cells predominate at first, finally hyphae; septate, elongate cells, 15-20 × 2-3μ up to 50 × 4-5μ. No asci observed. Cells rounded or ovoid, 4-6μ in diameter, increase by sprouting. Gram-positive.

On simple agar at 38°, small, rounded, isolated colonies, 2-4 mm., slightly elevated in the center, finely granulose at the periphery, dull white, becoming confluent. On litmus lactose agar, abundant development with a slight nile green color in the substratum. On glucose neutral red agar, good development, colonies take dye, no color change. On Sabouraud glucose agar, colonies dull white, 1-2 mm. Endo medium red with colonies taking dye. On gelatin stab, 18 small colonies, 1-2 mm. in diameter. No pigmentation, colonies superficial. Broth shows no turbidity or odor, milky white sediment formed, also sometimes there is a weak pellicle from floating islets. In bile broth, no turbidity, but there is a precipitate. No indol formation. Ferments fructose and maltose. Acid formation strong with galactose and arabinose, slight with fructose, maltose, and mannose. Glucose not fermented. On coagulated human serum, there is slight development, no liquefaction or pigmentation. Milk slightly acidified without coagulation. Gelatin not liquefied.

Castellania alba (Castellani & Chalmers) Dodge, n. comb.

Monilia alba Castellani & Chalmers, Man. Trop. Med. ed. 3, 1089, 1919.

Source of organism and pathogenicity not mentioned.

Colony white on glucose agar. Thin pellicle on broth. Acid formation and fermentation with glucose, maltose, and galactose, acid only with sucrose. Milk coagulated. Neither coagulated serum nor gelatin liquefied.

Perhaps the organism described by Forgues should be referred to this species. Below is a description based on Forgues' thesis:

Parendomyces sp. Forgues, Thèse de Bordeaux **87**: 1-100, 1913.

Monilia de Forgues Sartory, Champ. Parasit. Homme Anim., 710-711, 1922.

Isolated from the exudate in the throat and from the sputum of a patient suffering from angina and pleuropneumonia. The soft palate, tonsils, pillars of fauces, and posterior surface of the pharynx were all covered with the whitish coating. Pulmonary symptoms appeared later. Fatal to white mice both by hypodermic and intraperitoneal injection. Organism recoverable. Pathogenic, though not always fatal, to guinea pigs and rabbits.

Yeast cells spherical, except where flattened by pressure, in groups of 10-20. Dimensions vary with medium, the diameter being 2-4μ in serum gelatin and 6-8μ in Raulin's liquid. On 15- to 20-day-old cultures on carrot, diameter sometimes as large as 15-20μ. Protoplasm surrounded by a cell wall and showed metachromatic granules and vacuoles. Hyphae appear on older, solid cultures, measuring 1-2μ in diameter and 80-100μ in length. At intervals of 30-40μ there is a gap of 2-3μ in length, which is not colored by the dyes which stain the remainder of the protoplasm. Hyphae rarely branch but yeast cells may be attached anywhere. Pseudomycelium present, 5-20 × 5μ. Reproduction by sprouting.

On agar, growth very poor, very tiny colonies. On malt agar, colony abundant, not folded, with regular pointed projections from border. On Sabouraud medium, uniform colonies, irregularly folded, often mammillate or cracked, rarely reaching the walls of the tube. On potato and glycerol, colony abundant in 48 hours, grayish white rapidly developing, thick, uniform with occasional elevations, covering whole carrot surface in a few days. Grayish white sediment at the bottom of the tube, with some membranous clots above. On carrot and glycerol and on carrot and 5% glucose in 12 hours grayish white, creamy colonies which are confluent in 48 hours, covering whole surface of carrot with thick coating. In 20 days, culture has dried and cracked transversely and in circles, powdery whitish sediment at bottom of the tube. On gelatin, small punctiform colonies in 15-20 days. On stab, growth similar both at surface and in depths. Colonies similar but confluent, on serum gelatin with simple syrup. Growth similar on serum gelatin with glycerol, acid, or alkali. In plain broth, slight sediment in 48 hours, liquid clouds with formation of clots which sink to bottom, no pellicle, liquid clears in 20 days. Growth similar in broth with tartaric acid, 5% glycerol, or 5% glucose. In 20% glucose broth, a slight pellicle appears to form, but this is composed of clots which finally sink to the bottom. Growth similar in Raulin's medium. Growth absent or negligible in the presence of peptone.

Acidification and fermentation with glucose, fructose, galactose, maltose, lactose, and dextrin; none with sucrose, starch, inulin, glycerol or mannite. Coagulated serum and gelatin not liquefied.

Castellania accraensis (Macfie & Ingram) Dodge, n. comb.

Monilia accraensis Macfie & Ingram, Ann. Trop. Med. Parasitol. **15**: 274, 1921, non al.

Monilia nivea ? Macfie & Ingram, Ann. Trop. Med. Parasitol. **15**: 53-58, 1921, non al.

Candida acraensis Basgal. Contr. Estudo Blastomycoses Pulmonares 49, 1931.

A complicating organism in fatal cases of tuberculosis of the lungs.

Colonies diffuse and creamy white on most media. Thick white colony on potato. White deposit in broth and peptone water, slight pellicle on peptone water. Hyphae only on liquid media. Acid formation and fermentation with glucose, galactose, and sucrose, slight also with maltose, none with other sugars. Coagulated serum and gelatin not liquefied.

Differs from *Castellania nivea* by not fermenting raffinose.

Castellania paratropicalis (Castellani) Dodge, n. comb.

Endomyces paratropicalis Castellani, Centralbl. Bakt. I, **58**: 236-238, 1911.

Monilia paratropicalis Castellani, Jour. Trop. Med. Hyg. **17**: 307, 1914.

Atelosaccharomyces paratropicalis Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 264-268, 1918.

Myceloblastanon paratropicale Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida paratropicalis Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Isolated from case of bronchomycosis, also from two cases of blastomycetic dermatitis in Ceylon.

Thin pellicle formed on broth. Acid formation and fermentation with glucose, fructose, galactose, sucrose, and maltose. Very slight acid with dextrin. Milk not coagulated.

Castellania enterica (Castellani) Dodge, n. comb.

Endomyces enterica Castellani, Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia enterica Castellani & Chalmers, Man. Trop. Med. ed. 2, 827, 1913; Delamare, Bull. Mém. Soc. Hôp. Paris **43**: 572-575, 1919.

Myceloblastanon entericum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida enterica Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Isolated by Delamare from the stools of a patient with chronic diarrhea in Senegal. Produced lesions in rabbit ear, slight symptoms in guinea pig and, administered per os, produced typical diarrhea in cat.

On glucose and lactose agars, growth is rapid, and white granular colony forms. On maltose, mannite, and sucrose agars, growth is in projecting tufts, umbilicate, surrounded by a striate zone and by an almost transparent aureole. Ivory tint on ageing. On fructose agar, meager growth. On stab in ordinary agar, colonies are bright, white, rounded, elevated with umbilicus or central papilla. Growth stationary after fifth day. On neutral red agar, colonies are tinted rose, agar yellowing. On potato, there is a white, dry growth with elevations like the contours of a map, also erratic round colonies of pinhead size. On carrot, growth is a white folded membrane with festooned edge. Water of condensation is milky. On beet, growth is white with a rosy tint, bristling with little papillae, border festooned and projecting. On artichoke, colonies are verrucose, café-au-lait in color on ageing. Substrate turns green on sixth day, black on the eighteenth day. On gelatin, surface growth is slow and in the form of little white nodules. In the depths, growth appears arborescent. On gelatin with glycerol, glucose and liver infusion growth is meager. On coagulated serum, colonies punctiform. In hay infusion, a slight pellicle forms with whitish flakes settling out and leaving the medium clear. In broth, there is a white deposit at the bottom of the tube with slight temporary cloudiness. In bichromate broth, as above, with cloudiness persistent. Acid formation and fermentation with glucose, fructose, maltose, galactose, sucrose; slightly acid with mannite and dextrin. Litmus milk turns slightly alkaline at first, then is decolorized below. No coagulation. No liquefaction or discoloration of coagulated serum. No liquefaction of gelatin.

PARASACCHAROMYCES

Parasaccharomyces Beurmann & Gougerot, Tribune Méd. **42**: 502, 1909.

The type species is *Parasaccharomyces Sambergeri* Beurmann & Gougerot based upon *Pseudosaccharomyces Busse* Šamberger.

Colony creamy, hyphae straight, long; yeast cells ellipsoid, thick-walled; ascospores not seen. No pellicle produced on liquid media, sometimes a ring with aerial hyphae; gelatin liquefied, sugars fermented.

This genus, originally described from ulcers, has since been reported from onychomycosis and from the respiratory and alimentary tracts.

Key to Species

Only glucose and fructose fermented.	
Colony bluish gray, from subcutaneous ulcers.	*P. Sambergeri.*
Colony yellowish or grayish brown, from onychomycosis.	*P. oosporoides.*
Other sugars fermented.	
Maltose not fermented, from sputum.	*P. parachalmersi.*
Maltose fermented.	
Sucrose not fermented.	
Milk coagulated, from sputum.	*P. Colardi.*
Milk acidified but not coagulated, from feces.	*P. intestinalis.*
Sucrose fermented.	
Galactose fermented, from sputum.	
Milk not coagulated.	*P. irritans.*
Milk coagulated.	*P. Talicei.*
Galactose not fermented.	*P. crateriformis.*

Parasaccharomyces Sambergeri Beurmann & Gougerot, Tribune Méd. **42**: 502, 1909.

Pseudosaccharomyces Busse Šamberger, Sbornik Klinicky **5**: 466-485, *Pl. 6,* 1904.

Isolated from a lesion which started as a vesicle, then a pustule on the left nostril accompanied by pruritus and spread by scratching. The central area a scar covered with fine scales, caused by the peeling of the horny layer. Around this scar is an ulcerous area with the margin elevated, light red. In this area are small pustules, and the crust is thick, uniform, confluent, covering the whole. Pathogenic for mice.

In pus, cells spherical or ovoid, thick-walled, yellowish, often in pairs, occasionally showing sprouting. In cultures, cells ellipsoid, thick-walled, with long straight or slightly curved hyphae, cells 10-12μ.

On Zopf medium [water 1,000 c.c., ammonium tartrate 10 gm., dihydrogen potassium phosphate 5 gm., magnesium sulphate 2.5 gm., calcium phosphate 0.5 gm., peptone 10 gm., sucrose 140 gm.], colony thick, bluish gray, margin shining, even, opaque. On potato, surface rough, verrucose, gray or tan gray. In gelatin stab, colony like a large nailhead with only slight growth along the stab. On liquid media, a ring with aerial hyphae in 3 weeks. Gelatin liquefied in 3 weeks; glucose fermented.

Parasaccharomyces oosporoides (Zach) Dodge, n. comb.

Blastodendrion oosporoides Zach in Wolfram & Zach, Arch. Derm. Syphilis **169**: 102, 103, 1933.

Isolated from a case of onychomycosis. Perhaps the organism of Mackinnon (1934), *Geotrichoides strain 464,* belongs here.

Cells ovoid, rarely spherical, thick-walled, with a large vacuole and 1-2 oil globules, 6.5μ in diameter, ovoid cells 5-6.5 × 7.5-9.7μ. Sprouting at both ends or irregular, after 3 months forming long branched hyphae with occasional blastospores at the septa. Hyphal cells elongate, ends rounded, blastospores shorter ellipsoid, not lacrimiform.

On agar, colony whitish, dull, surface and margin smooth, later becoming yellowish and margin less regular and wavy. On gelatin, colony grayish, dull, margin smooth at first, later wavy, sinking into the gelatin. On gelatin, stab growth superficial with some colonies along the stab. On potato, colony thick, grayish yellow, dull. On carrot, colony white, moist. On maltose broth and autolyzed yeast floccose sediment, no cloudiness and no pellicle. Glucose and fructose fermented. Gelatin liquefied on the ninth day.

The following two unnamed species of imperfect fungi may possibly be referred to *P. oosporoides* but present some minor differences. The first agrees rather closely with Zach's description, while the second seems deserving of varietal rank. It is to be hoped that a sufficient number of strains of this organism may be studied to give us more information on variation. This species should also be compared with *Mycocandida onychophila* (p. 294).

[*Monilia* sp.] Dübendorfer, Derm. Centralbl. **7**: 290-302, *3 figs.,* 1904.

Isolated from a case of onychomycosis. Pathogenic to laboratory animals.

Cells long, ovoid or ellipsoid. Hyphae present.

Colonies round, hemispheric, elevated with shiny porcelain-like surface. On malt agar, colonies large and flat. On potato, growth in small, hemispheric colonies sending out radiations which join them in moniliform groups. Growth white, becoming gray in 1-2 months. On alkaline gelatin stab, growth in form of lateral small foliiform projections into medium. In broth and malt extract, a flocculent sediment without turbidity, no pellicle. Glucose fermented, maltose and sucrose not. Alkaline gelatin not liquefied but malt gelatin finally liquefied.

Var. **Guggenheimi** Dodge, n. var.

Oidium sp. Guggenheim, Arch. Derm. Syphilis **142**: 305-309, 1923.

Produces onychomycosis. Human inoculation positive. Intravenous injection in guinea pig fatal in 10 days.

Colonies gray brown, smooth, shining, round elevations, after 2 weeks becoming silvery powdery, then gradually resuming gray brown color. No growth on malt agar. In beef broth, gray sediment appears but no turbidity. Glucose fermented, gelatin liquefied.

Parasaccharomyces parachalmersi (Castellani & Chalmers) Dodge, n. comb.

Monilia parachalmersi Castellani & Chalmers, Man. Trop. Med. ed. 3, 1087, 1919.

Myceloblastanon parachalmersi Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from sputum. Acid formation and fermentation with glucose, fructose, galactose, sucrose, and inulin. Milk coagulated. Gelatin slowly liquefied.

Parasaccharomyces Colardi Dodge, n. sp.

Monilia sp. Jaumain & Colard, C. R. Soc. Biol. **93**: 858-860, 1925; Colard & Jaumain, Bruxelles Méd. **5**: 1503-1506, 1925.

Isolated from the sputum in a case of bronchomycosis (fatal) in the Belgian Congo which was under observation in 1924-1925. Shortly before death, the same organism was isolated from ulcers in mouth and pharynx. Pathogenic for rabbits.

In sputum, cells $4\text{-}5 \times 2\text{-}3\mu$, granular, often united in pairs. Yeast cells and branched hyphae bearing terminal chlamydospores. On solid sugar media, mostly yeast cells or occasional short chains of long cells forming pseudomycelium. Optimum temperature 37° C.

On solid sugar media, colony thick, creamy white, not changing color with age. On carrot sediment, some floating flakes in the liquid, no pellicle or ring. Abundant sediment in malt extract. Acid and fermentation with glucose, fructose, maltose, and dextrin. Acid only with galactose and sucrose. No action with lactose, mannite, inulin, or starch. Litmus milk acidified, coagulated after 8 days in the incubator when it again becomes alkaline. No action on coagulated serum. Glucose gelatin liquefied in 10 days.

Parasaccharomyces intestinalis (Mattlet) Dodge, n. comb.

Blastodendrion intestinale Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 16-17, 1926.

One of the organisms isolated from stools of patients suffering from dysentery in Belgian Congo.

In potato decoction at 37° after 3 days, yeast cells ovoid, 2.5-3.5 × 5-8μ, vacuolate, sprouting to give spherical cells, 2-3μ in diameter which soon elongate; hyphae, simple or slightly branched, composed of 12-20 cells with small area of contact. After 30 days the yeast cells contain fat droplets and some are thick-walled, spherical, 7-8μ in diameter with a crown of granulations as in *Atelosaccharomyces pyogenes.* The hyphae become firmer, not easily dissociated, with larger areas of contact between cells.

On Sabouraud agar at 37° C., colony round, white, dull. Later the center yellows and crumples, with radial folds at the lobate margin and verrucose projections into the medium. On gelatin stab, colony develops similarly with abundant granulations, as large as 1 mm. in diameter, along stab. In potato decoction, white lumpy sediment. Optimum for culture, 37° C. Milk slightly acidified. Fermentation of glucose, fructose, maltose, galactose; none of sucrose, lactose, mannite, dextrin, inulin. Gelatin liquefied with evolution of gas.

Parasaccharomyces irritans (Mattlet) Dodge, n. comb.

Blastodendrion irritans A Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 18-19, 1926.

Isolated from the sputum in several cases of mycosis of the respiratory tract with dry cough in long drawn-out fits of varying degrees of severity. Treatment with potassium iodide, emetine, and arsenicals gave improvement. although the parasite generally remained in the sputum.

In sputum, yeast cells, spherical or ovoid, 2-5μ in diameter, sprouting or in groups. After 3 days at 37° in potato decoction, single cells, ovoid or spherical, with numerous granulations and rather rare types of cellular groupings. Spherical cells up to 6μ in diameter, ovoid cells 3.5 × 7μ. Groupings consist of an axis of elongate cells, 10 × 3μ, from whose septa grow either lateral filaments, or spherical cells, or chains of cells. Between the elongate cells sometimes grow intercalary spherical cells. Free ends of cells always rounded. Same after 30 days. Optimum temperature for growth 37° C.

On Sabouraud agar, colony round, cream colored at the smooth margin with yellow center, surface smooth and slightly shining, the center wrinkling slightly in age, no submerged mycelium. On gelatin stab, small cup of liquefaction after 20 days. In depths numerous granulations along the stab, medium displaced. In potato decoction, sediment of grayish white clots which break up on agitation. Fermentation of glucose, fructose, maltose, galactose, sucrose, none of lactose, mannite, dextrin, inulin. Slight acid formation with milk but no coagulation. Slight gas with gelatin, also liquefaction.

The following strain B described by Mattlet differs in minor particulars but scarcely seems deserving of varietal rank.

Blastodendrion irritans B Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 18-20, 1926.

Monilia sp. (case V) Mattlet, Ann. Soc. Belge Méd. Trop. **4**: 173, 1925.

Isolated from cases clinically similar to those of the species. In the case V Soter, *Aspergillus giganteus* was isolated by Mattlet at the same time as *Blastodendrion irritans*.

After 3 days at 37° C. in potato water, many spherical cells, 6μ in diameter, and ovoid cells 7-8 $\times$ 4μ, with a large central vacuole. Rare elongate cells, 8 $\times$ 3μ, forming hyphae when attached end to end. At the septa, sprout single elongate or spherical cells. After 30 days all cells show fatty granulations.

On Sabouraud agar, appearance as in *P. irritans A*, except margin lobate and tufts of hyphae penetrating deeply into substrate. Action on sugars differs from *P. irritans A* only in intensity. Litmus milk at first slightly acid, then alkaline. Gelatin liquefied, gas evolved.

Parasaccharomyces Talicei Dodge, n. sp.

Monilia sp. Talice & Mackinnon, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **4**: 502-519, *13 figs.*, 1928.

Isolated from the sputum of a case simulating pulmonary tuberculosis without showing presence of *Mycobacterium*. Pathogenic to rabbits on intravenous injection, to white rat on intraperitoneal injection, but not found pathogenic to guinea pig.

Rare hyphae in sputum. Blastospores present. In culture, blastospores of variable size, spherical, 2-11μ in diameter, averaging 5-6μ, ovoid 5-7μ in diameter, sometimes forming chains in cultures more than 3 days old. Blastospores germinate by septate hyphae, 10-30 $\times$ 2μ, which in turn give rise terminally and laterally to hyphae and blastospores. Hyphae increase in number as the culture ages, but yeast forms always predominate. In very old cultures the hyphae form arthrospores. Protoplasm generally granular and shows oil droplets. Gram-positive, stained with May-Giemsa stain. Optimum temperature for growth 36°-38° C., grows anywhere between 18° and 40° C., does not grow above 45° C.

Giant colony, after 16 days, is 4-5 cm. in diameter, approximately circular, granular at the center, with radiating furrows which end in indentations at the margin, generally white but assumes color of the medium. On plain or Gorodkova agar, a moist and white covering. On potato, colonies of irregular outline, verrucose. On carrot, surface colonies which grow rapidly and become folded. On Sabouraud glucose agar, growth very good, forming a moist thick covering which acquires the color of the medium. On ordinary Sabouraud agar or Sabouraud with maltose, growth similar but less abundant. On Sabouraud conservation agar, growth poor, verrucose. In glucose broth, a very light pellicle which clings to sides of tube. Similar on Raulin's liquid. Acidification and fermentation with glucose, maltose, galactose, sucrose, inulin, and levulose, none with lactose, mannite and dulcite. Litmus milk acidified and coagulated, then alkaline. Slight growth on coagulated serum. Gelatin rapidly liquefied.

Parasaccharomyces crateriformis Dodge, n. sp.

Oidium sp. Spiethoff, Jahrb. Hamburg. Staatskrankenanst. **9**: 167-208, *Pls. 14, 15,* 1905.

Isolated from lesions about the genitalia and adjacent thigh, also from the urine of a diabetic woman. Pathogenic for laboratory animals.

Cells spherical to ovoid with some filaments.

Colonies on agar, glucose agar, malt agar, and blood agar, white, moist, without aerial hyphae; on blood serum, growth poorer; on gelatin, colony thick, white, crateriform, margin with short radial furrows. On potato, colony at first white, moist, becoming dry and chalky. In liquid media, a ring but no pellicle developed. with a fine flocculent sediment. Coagulation of milk usually negative but observed after several days in a few tubes. Glucose, sucrose, and maltose fermented. Gelatin liquefied.

MONILIA

Monilia Bonorden. Handb. Allg. Mykol. 76, 1851.

Candida Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 54-56, 1932.

The type species is *Monilia candida* Bonorden (*Monilia Bonordeni* Vuillemin).

Colonies creamy, thick, convex, beginning by bipolar sprouting of the blastospore and followed by extensive branching, blastospores appearing late. Blastospores ovoid, produced only terminally. Pseudomycelium of ellipsoid cells, terminal cells prolonged into simple or compound chains, no verticils (Fig. 49). Pellicle developing in liquid media, gelatin liquefied, sugars fermented.

This group is predominantly saprophytic. It is quite possible that *Mycotorula* Will may belong here, but its morphology has been so poorly described that one cannot be certain. The description of *M. Bonordeni* is included here because pathogenic cultures have so often been incorrectly referred here. *M. Kochi,* inadequately described, should be recognized by its red color.

Monilia Bonordeni Vuillemin, Bull. Soc. Myc. France **27**: 140, 1911.

Monilia candida Bonorden, Handb. Allg. Mykol. 76, 1851, not Persoon, Syn. Meth. Fung., 693, 1801.

Endomyces candidus Castellani, Lancet **1**: 13-15, 1912.

Myceloblastanon candidum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida Bonordeni Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Forms a woolly, granular, snow-white covering on rotten wood, about 2 mm. thick. Not pathogenic.

Cells spherical to short ovoid. In older cultures and in pellicles also long sprouting cells and very long, septate branched hyphae, bearing terminal chains of ovoid or spherical white blastospores. Blastospores sprouting.

Giant colonies usually pure white, moist, shining, elevated. With age the surface becomes somewhat drier, with a depression in the center which appears hairy. The periphery is correspondingly elevated. The gelatin adjacent to the surface colonies is somewhat depressed. The colonies in the depths of the medium appear spherical or star-shaped. Culture has a pleasant, sour odor. On malt gelatin streak, growth is broad, thick, white, with deep folds starting parallel to the streak and ending perpendicular to the periphery. With age, colony becomes dry and powdery. Growth similar on stab though not much in depths of medium. In malt extract, beer, or whey, a pellicle is formed. In the latter at 25° C., abundant, flocculent growth. Ferments glucose, fructose, maltose, and sucrose. Malt gelatin slightly liquefied in 2 weeks, completely in 6-8 weeks.

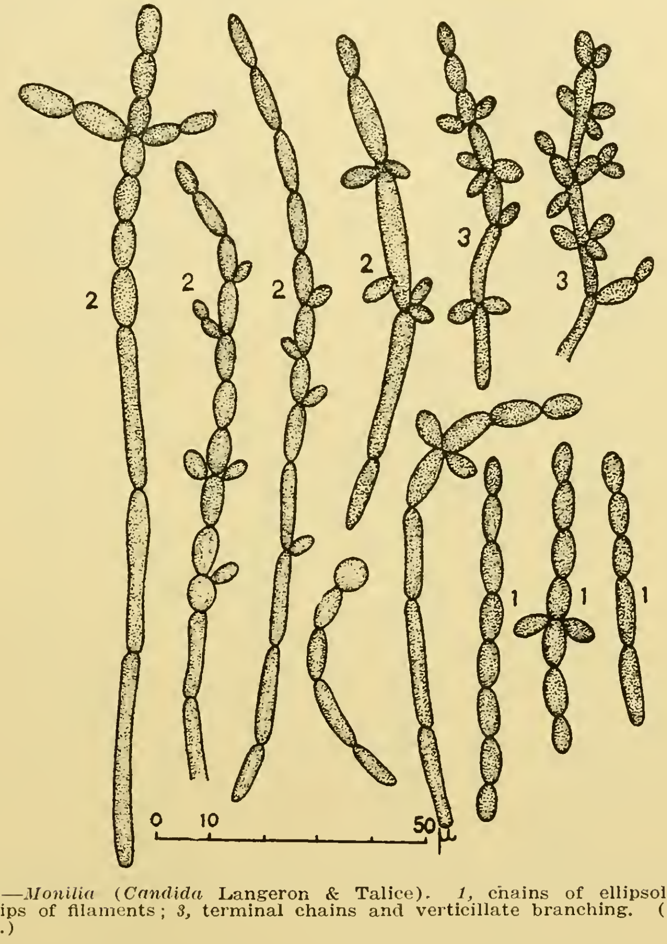

Fig. 49.—*Monilia* (*Candida* Langeron & Talice). *1*, chains of ellipsoid blastospores; *2*, chains at tips of filaments; *3*, terminal chains and verticillate branching. (After Langeron & Talice 1932.)

Monilia Kochii (Wettstein) Saccardo, Syll. Fung. **10**: 518, 1892.

Rhodomyces Kochii Wettstein, Sitzungsber. K. Akad. Wiss. Wien. **91**: 33-58, 1885.

Rhodomyces erubescens Apel apud Ascher, Zeitschr. Hyg. Infektionskrankh. **34**: 475-481, *Pl. 5,* 1900.

Candida Kochii Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Isolated from human sputum repeatedly over a period of 2 years. In the stomach of a cat fed with milk, it sprouted and formed conidia. Seems to be connected with pyrosis. *R. rubescens* was isolated from the placenta and fetal skin of a guinea pig, but is not pathogenic for experimental animals.

Mycelium in substrate colorless, thin, one- to several-celled. Hyphal cells 20-60 × 6-16μ with thin membrane. Conidiophores rise above substrate, rose red to yellowish red, formed of spherical or short cylindric cells, much branched. Conidia in chains which finally dissociate, ovoid to polyhedral, 5-16μ in diameter or 15-20 × 6-15μ with relatively thin wall and hyaline content, finally breaking up into a powdery mass. Intercalary chlamydospores also present. Hyphal anastomoses observed.

Colonies rounded, rose-red or red-yellow, covered by a pulverulent conidial layer 1-2 mm. thick, aerobic. Sugars not fermented. Milk slowly coagulated and digested. No ring or pellicle on liquid media.

The species of *Oidium* referred to as *Oidium rose* by Sartory & Orticoni, Rev. Path. Comp. **14**: 176, 1914, but not fully described, perhaps belongs here. Hyphae repent, 3-4μ in diameter, rose color. Fertile hyphae terminated by a chain of ovoid, pale rose spores, 2.5-3 × 2μ. Not pathogenic but found along with pathogenic *Cryptococcus* sp. described in same paper.

SYRINGOSPORA

Syringospora Quinquaud, Arch. Physiol. Norm. Path. **1**: 290-305, *Pl. 8,* 1868.

?*Enantiothamnus* Pinoy apud Brault & Masselot, Ann. Derm. Syphiligr. V, **2**: 602, 1911.

Mycotorula Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 43-48, 1932.

The type species is *Syringospora Robini* Quinquaud (*Oidium albicans* Robin).

Colonies creamy, thick and convex, beginning by polar sprouting of a blastospore, followed by the progressive branching of the pseudomycelium; blastospores spherical or ovoid, rarely elongate, arranged in simple verticils at the septa along a hypha; pseudomycelium formed of short cells, each typically terminated by a verticil of blastospores; terminal cell similar, very rarely terminated by a short chain; verticils simple, regularly spaced, sometimes limited to 4 or 6, sometimes in dense clusters (Fig. 50). Gelatin liquefied, sugars fermented.

With some hesitation has *Enantiothamnus* been referred here, on account of its morphology, although several characters suggest a relationship with *Proteomyces*. Biochemical characters which often provide a clue to the relationships are not given in the original description. Langeron & Talice (1932) doubtfully referred it to their *Geotrichoides* (*Candida* Berkhout).

The members of this genus grow predominantly on mucous membranes of the respiratory and alimentary tracts and about the external genitalia, extending into the urethra in man. They seem to be saprophytes or mild parasites which grow much better on artificial media and produce injury largely by mechanical and perhaps chemical irritation rather than by invading the tissues. I have also referred here several partially described organisms found growing on the moist folds of skin, causing local irritation often clinically resembling those caused by *Epidermophyton*. *S. Braulti* (*Enantiothamnus*) alone in the group produces subcutaneous lesions.

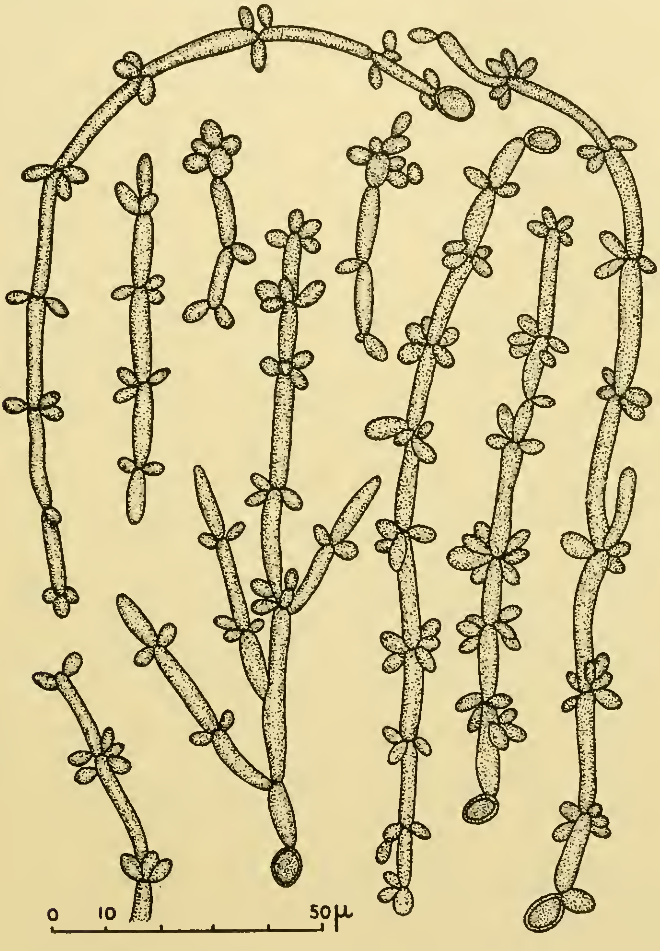

Fig. 50.—*Syringospora* (*Mycotorula* Langeron & Talice) showing regular, dense verticils without terminal chains. (After Langeron & Talice 1932.)

Key to Species

Pellicle formed on liquid media.	
Verticils dense, cells nearly spherical.	*S. albicans.*
Verticils scanty (4-6 cells), cells slightly elongate pointed at one end.	*S. Braulti.*
No pellicle on liquid media.	
Gelatin not liquefied.	
From moist folds of skin.	
Colony margin even.	*S. interdigitalis.*
Colony margin dendroid, sugars fermented.	*S. cutanea.*
From digestive tract.	
Maltose not fermented.	*S. Tonge.*
Maltose fermented.	*S. psilosis.*
Gelatin liquefied.	
Sugars not fermented, from cornea.	*S. Cavarae.*
Galactose and sucrose fermented.	*S. Issavi.*
Galactose and sucrose not fermented.	*S. Negroni.*

Syringospora albicans (Robin) Dodge, n. comb

Sporotrichum sp. Gruby, C. R. Acad. Sci. Paris **14**: 634-635, 1842.

Oidium albicans Robin, Hist. Nat. Vég. Paras. 488-513, 1853.

Stemphylium polymorphum Hallier, Die Pflanzl. Paras. des Menschl. Körpers, 1866.

Syringospora Robini Quinquaud, Arch. Physiol. Norm. Path. **1**: 290-305, *Pl. 8,* 1868.

Saccharomyces albicans Reess, Sitzungsber. Phys. Med. Soc. Erlangen **9**: 190-195, 1877.

Mycoderma vini Grawitz, Deutsch. Zeitschr. Prakt. Med. **1877**: 209-211, 220-223, 1877, non aliorum.

Monilia candida Plaut, Beitr. z. Syst. Stellung d. Soorpilzes, 16 pp., 1885, non Bonorden.

Dematium albicans Laurent, Bull. Soc. Belge Micr. **16**: 14, 1890.

Monilia albicans Zopf, Die Pilze 478-480, 1890.

Endomyces albicans Johan-Olsen, Centralbl. Bakt. II, **3**: 276, 1897, non Vuillemin.

Parasaccharomyces albicans Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 271-272, 276-277, 1918.

Myceloblastanon albicans Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida albicans Basgal, Contr. Estudo Blastomycoses Pulmonares, 49, 1931.

Mycotorula albicans Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 44, 1932.

The disease caused by the group of organisms centering about *Syringospora albicans* has been known clinically since the time of Hippocrates as "stomata aphthodea" and Galen "aphtae alba" and "aphtae infantum." Later it became known as "aphta lactamen" and "aphta lactantium," and in modern literature thrush, muguet, sapinho and Soor. Langenbeck (1839) recognized the presence of the fungus in the disease, although he did not differentiate it from typhus, which it often follows, but Berg (1842) discovered the constant association of the fungus and gave a few morphologic details. Various workers during this decade place the organism in various genera without adding greatly to existing knowledge. Robin (1847) described and figured the organism, placing it in *Oidium* without naming it until the revised and greatly enlarged edition of his work in 1853. Haussmann (1870) followed Robin's opinion in his *Die Parasiten der weiblichen Geschlechtsorgane*. Quinquaud again studied the organism and placed it in his new genus *Syringospora,* describing the characteristic clusters of blastospores. Many minor works and case histories appeared without affecting nomenclature until Grawitz (1877) called it the same as *Mycoderma vini,* which opinion gave rise to polemics. While this was unfortunate, Grawitz did call attention to the differences of yeast form and mycelial form, and described chlamydospores. He discusses the action of media on morphology but his observations are to be distrusted on account of the crude state of cultural technic, so that he may have been working with mixed cultures. Reess (1877) showed that the organism was distinct from *Mycoderma vini* and called it *Saccharomyces albicans.* This gave rise to further polemics (summarized by Fischl). Kehrer (1883) studied the physiology of the organism from the standpoint of mode of infection and treatment. Plaut (1885) was the first to apply modern cultural technic, and he identified the mycelial form with *Monilia candida* Bonorden on decaying wood. Stumpf (1885) concluded he had two organisms, one filamentous and one yeast, both liquefying gelatin. Baginsky (1885) studied the organism on various media, and Klemperer (1885) produced experimental mycoses from intravenous injections. Grawitz now abandoned his view of relationship to *Mycoderma vini.* Plaut (1887), after a long and detailed study with much new data, reaffirmed the identity of his organism with *Monilia candida* Bonorden.

The first connection between yeast and mycelial forms was proved by Audry (1887), showing that the former were common on solid media, the latter in liquids. He described his colonies as follows: Colonies lobulate, pure white, mammillate on gelatin, no liquefaction. On agar and glycerol agar colonies smooth, whitish. On potato, dirty white; on liquid media, broth turbid, no pellicle, cells elongate in chains. This description is still too generalized to place the organism definitely, but it represents an advance over those of previous workers. In 1890 Linossier & Roux studied the physiology in great detail, giving extensive notes on carbon and nitrogen metabolism without definitely describing biochemical reactions. They describe their organism as producing white, elevated, creamy colonies, with surface slightly furrowed on cooked carrot. At first the yeast cells predominate, then a short period of some filaments and then yeast cells again. On liquid media, the filamentous forms predominate except in malt extract. On most fruits (except melon) and on peptone gelatin, the yeast form is abundant, while on sucrose gelatin, both forms are found. No ascospores observed, chlamydospores not uncommon (Fig. 50).

The description of Fischer and Brebeck (1894) is the first which enables us to recognize the organism from its cultural description, consequently it may be taken as a standard for the description of cultural characters and associated with the morphology so well figured by Quinquaud in 1868.

This organism or rather the various strains (mostly very imperfectly described morphologically and culturally) referred here by their authors, seem to be largely facultative parasites, which may invade many tissues when bodily resistance is lowered by disease, senility, etc. The organism is most frequently reported on infants and aged persons, usually in the mouth. This or similar organisms have been reported from the throat in angina, and from the tonsils, the nipples of nursing mothers, occasionally on skin of badly infected infants, bronchial tubes (old cases probably to be referred to other species of this group), in the bladder of diabetics, in female genitalia, and in the alimentary canal. It will be noted that many of the cases cited by Fischl (1919) date from the time when it was customary to call any mycelium-producing yeast from the human cases *Monilia albicans* or one of its synonyms without comparison with descriptions of previous strains. The only way to prevent further confusion seems to be to take the description of Fischer & Brebeck (1894) as a standard and name strains which are not conspecific with it as something else.

Occurring on the mucous membrane of the vagina and in the mouths of infants. Pathogenic to rabbits when inoculated in eye.

In young malt extract cultures, cells spherical or ovoid, very variable in size, sprouting. Also occasional elongate cells connected in short chains or longer pseudomycelium. In cultures from room temperatures to 27° C., cells show large vacuoles and one or more metachromatic granules. In malt extract cultures several weeks old, spherical cells 8μ or more in diameter, also short-ovoid, occasional elongate-ellipsoid and filiform cells. Also longer, septate, branched mycelium like that of molds. Similar morphology on old whey cultures with the spherical sprout cells attaining a diameter of 18-20μ. Each cell contains 1-4 fat droplets 1.5-4μ in diameter (Fig. 51).

Giant colonies white to yellow-white, moist, shining, projecting to 2 mm. above the gelatin, guttiform to conic, pulpy in consistency. On gelatin streak, a thick, yellowish white, moist colony which (after liquefaction of the substrate) sinks to the bottom in the form of a thick, grayish powdery white or pulpy sediment, leaving the gelatin clear. On stab growth in all directions like a root system. On malt extract between 25° and 27° C., a smooth, dull grayish white pellicle. Glucose, levulose, and maltose fermented. Sucrose only fermented after it has been inverted by the acids formed. Gelatin rapidly liquefied (liquefaction complete in 2 weeks).

Syringospora Braulti (Pinoy) Dodge, n. comb.

Enantiothamnus Braulti Pinoy in litt, apud Brault & Masselot, Ann. Derm. Syphiligr. V, **2**: 592-602, *7 figs.*, 1911; Brault, Bull. Soc. Path. Exot. **7**: 90-91, 1914; Bull. Mém. Soc. Chirurg. Paris **37**: 405-407, 1911 [original case history with cultural characters but organism not named].

Monilia Braultii Vuillemin, Champ. Parasit. Homme Anim. 87, 1931.

Blastodendrion Braulti Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 62, 1932.

Isolated from slight crateriform tumors on buttock of an Arab in Algeria. Craters opened in a few days, exuding pus, then healed(?). Epidermis not altered. Tissues infiltrated. Subcutaneous injection gave slight lesion in rat, doubtful in guinea pig; nonpathogenic to rabbit and hen.

On carrot broth, hyphae 2.1μ in diameter, cells 6.5-10μ long, end cells swollen to 2.8 × 3-7μ. A few branches several cells long. Spores verticillate at septum, 2-2.5 × 1-1.5μ. Thallus easily dissociating. Stained by crystal violet, gentian violet, Ziehl, Giemsa, less by thionin, Borrel blue, Loeffler blue, and Unna blue.

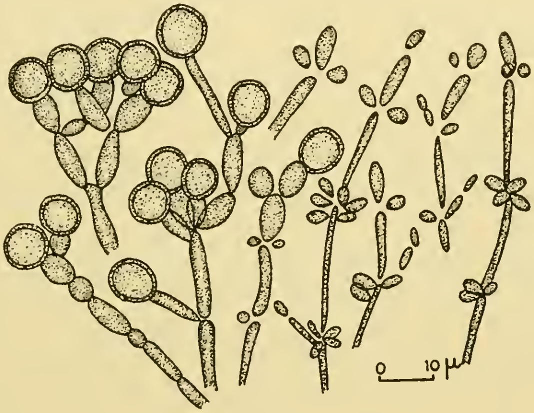

Fig. 51.—*Syringospora* chlamydospores. (After Langeron & Talice 1932.)

Cultures grow at room temperature and 37° C. Colony on Sabouraud agar, colony dull white slightly yellowing, with slight depressions. Margin thicker, finely folded, more brilliant. On glucose agar, after 48 hours, colony thick, center dense, becoming yellowish, margin thinner. Glycerol-glucose agar seems more favorable, center yellow, granular to mammillate, very thick, margin thin, grayish, folded. On potato, colony small, meager. Neither carrot, carrot-glycerol, nor carrot broth very favorable. On ordinary agar, whitish, thick velvet. Velvet on stab at surface with grayish streak in deeper layers. On broth, pellicle forms and medium becomes cloudy.

Syringospora interdigitalis (Pollacci & Nannizzi) Dodge, n. comb.

Cryptococcus interdigitalis Pollacci & Nannizzi, I Miceti Patog. **5**: No. 44, 1926; Marengo, Arch. Ital. Derm. Sifiligr. Venereol. **1**: 464-477, *2 figs.*, 1926.

Mycotorula interdigitalis Radaelli apud Flarer, Arch. Ital. Derm. Sifiligr. Venereol. **7**: 415-478, *11 figs.*, 1931.

Torulopsis pulcherrima var. *variabilis* Lodder, Anaskosporogenen Hefen **1**: 144-146, 1934.

Isolated from interdigital lesions.

Cells mostly spherical 3.5-4μ in diameter, thin-walled. uniguttulate. Older cells spherical or ellipsoid 6-8.5 × 5.5-7μ, single or in pairs, thick-walled. Protoplasm at first homogeneous and granular, later vacuolate, blastospores sometimes solitary, sometimes in verticils about cylindric septate hyphae, 2-3.5μ in diameter, sparingly branched.

On Pollacci agar, colonies punctiform, moist, creamy, yellowish. Flarer reports colony dense, creamy, whitish, shining; margin smooth, regular, and confluent; slightly grayish when old. On malt agar, colony yellowish, shining, slightly radially striate, margin smooth. On malt gelatin, colonies irregularly reddish, flat, smooth, radially striate, margin sinuous. On malt extract, a thin ring and thin, slimy pellicle which soon sinks, slight odor of esters. On broth, an incomplete ring with a cottony, floccose sediment. On alcohol, a thin pellicle. Glucose, fructose, and mannose fermented. Gelatin liquefied in 75 days.

Syringospora cutanea Dodge, n. sp.

Myceloblastanon cutaneum var. Takahashi, Jap. Jour. Derm. Urol. **29**: 224-251, 318-331 [26-31], 1929.

Isolated from mycosis of interdigital spaces as well as of gluteal, perianal, inguinocrural, and axillary folds. In one case, isolated from neck of infant.

Yeast cells ovoid or ellipsoid, 2-4 × 3-5μ, granular at first, becoming vacuolate and thick-walled. Mycelium 2-5μ up to 50μ, septate. Mycelium formation is stimulated by the following factors: lowered temperature, high oxygen tension, slight acidity of substrate, depletion of nutrients, addition of carbohydrates, especially glucose, addition of "koji," growth on carrot, on man, or other mammals. Blastospores appear at the septa. often in dense clusters suggestive of a mulberry. No asci formed.

Colony on malt agar or Sabouraud glucose is brownish white, smooth, shining and creamy, with the margin showing dendroid projections of mycelium into the medium. On broth, producing a slight turbidity, ring, sediment, but no pellicle. Growth better on glucose broth. Glucose, maltose, fructose, mannose fermented, but not sucrose, galactose, raffinose, dextrin, lactose, or mannite. Gelatin not liquefied, though dendroid mycelium appears along the stab. Malt gelatin slowly liquefied. Milk acidified and coagulated, the optimum temperature for this being 37° C.

Syringospora Tonge (Mattlet) Dodge, n. comb.

Monilia Tonge Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 22, 23, 1926.

Isolated from cases showing symptoms of true dysentery and of enteritis. No amoebae or cysts found. Patients natives of Belgian Congo. Amelioration of symptoms and even cure on treatment with light purgatives in conjunction with emetine injections.

After 3 days at 37° C. in potato decoction, blastospores, spherical up to 7μ in diameter, each containing a big vacuole, sprouting at several points at once with these daughter cells sprouting in turn without separating from the mother cell. Hyphae formed of cells that lengthen with age, beginning about 20 × 2.5μ and ultimately attaining 30 × 1.5μ. The protoplasm of the cells is reduced to a thin layer along the wall. Verticils of spherical cells at the septa; lateral branches rare. After 30 days intercalary and terminal chlamydospores, which have a double membrane and a large vacuole, separate and float free. Optimum temperature for growth 37° C.

On Sabouraud agar at 37° C., colony round, dull white, with a smooth margin at first, developing outgrowths composed of large, contorted hyphae, which also grow down into the medium. On gelatin stab, culture white, with denticulate margin, horizontal hyphae growing in depth of culture give a growth of inverted cone shape. On potato decoction, white flaky sediment. Ferments glucose and fructose, not maltose, galactose, sucrose, lactose, mannite, dextrin, or inulin. Neither acid formation nor clotting in milk. No liquefaction of gelatin.

Syringospora psilosis (Ashford) Dodge, n. comb.

Monilia sp. Ashford, Jour. Amer. Med. Assn. **64**: 810, 811, 1915; Amer. Jour. Med. Sci. **150**: 680-692, 1915.

Monilia psilosis Ashford, Amer. Jour. Med. Sci. **154**: 157-176, 1917 [August].

Parasaccharomyces Ashfordi Anderson, Jour. Infect. Dis. **21**: 341-387, *Pls. 3-8,* 1917 [October].

Myceloblastanon psilose Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Mycotorula psilosis Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 47, 1932.

Candida psilosis Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Isolated from a patient suffering from sprue in Puerto Rico. Pathogenic to guinea pigs and rabbits.

In young cultures cells are spherical or slightly ovoid; in old cultures cells more variable, ovoid, elongate, ellipsoid, spherical, or irregular. Giant cells common, spherical, 3.5-5μ in diameter, with refractile oil droplet. Septate hyphae appear in hanging drop of gelatin and in old cultures. Hyphal cells 2-4μ in diameter, branching not uncommon but not typical. Sprouting may occur anywhere in young cultures but near ends of cells in old cultures. It is the normal method of multiplication.

On glucose agar streak, colony filiform, elevated, glistening, chalk-white, and smooth. Later center may become rugose or pitted, margin even or filamentous. On gelatin stab, growth at first filiform, later developing scattered bushy clusters of filaments. In liquid sugar media and malt extract there is a ring, but no pellicle. Liquid sugar media become at first acid, then more alkaline. Glucose, maltose, and fructose fermented. "Occasionally sucrose and galactose"—Anderson [probably due to sugar impurities or perhaps strains of *Castellania faecalis*]. Litmus milk alkaline but not clotted in 2 weeks. "Gelatin rarely liquefied"—Anderson.

Syringospora Cavarae (Pollacci & Turconi) Dodge, n. comb.

Cryptococcus Cavarae Pollacci & Turconi in Bencini & Federici, Atti R. Accad. Fisiocrit. Siena X, **3**: 746-766, *8 figs.*, 1928.

Isolated from primary corneal lesions in Siena, Italy. Lesions reproduced in the eye of a rabbit.

Cells spherical, 4-7μ, or ovoid, 6-9 × 4-6μ, sprouting, wall thick, homogeneous or uniguttulate, rarely biguttulate, hyaline or yellowish; later the cells elongate to subcylindric 14-24 × 3-5μ, sprouting only from the apex, forming a mycelium, septate, simple, or slightly branched. Blastospores in small verticils of only a few cells each.

On Pollacci agar, colony disciform, creamy, moist, milky white, then slightly yellowish, slightly elevated in the center, plane, or more or less rugose. Gelatin rapidly liquefied, milk not coagulated, no fermentation of sugars, slight assimilation of glucose, fructose, maltose, and galactose.

Syringospora Issavi (Mattlet) Dodge, n. comb.

Monilia Issavi Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 21-22, 1926.

Case history not given.

After 3 days at 37° C. in potato decoction, three types of growth: (1) Blastospores, spherical, 5-6μ, or ovoid, 7 × 4μ, containing a vacuole. (2) Groups, sometimes in chains, of several elongate cells (6-8 × 2.5-3.5μ), bearing at ends and at septa, spherical or ovoid blastospores. (3) Hyphae long, made up of elongate and narrow cells (3.0 × 26.5μ), not much narrowed at the septa, free ends rounded, with either spherical blastospores or other hyphae at the septa. After 10 days the hyphae form a felt in whose interstices appear free cells, some of which enlarge considerably, becoming, when ovoid, 8 × 4μ, and, when elongate, 15 × 2.5μ. In some young hyphae the end of a cell swells. After 30 days there is no further change.

On Sabouraud agar at 37° C., colony white, somewhat shining, yellowing, and thickening with age, becoming irregular with radiating striations at margin, giving a fringed appearance. Abundant growth of hyphae into medium, giving it a granular appearance under a magnifying glass. On gelatin stab, same appearance at surface, medium becomes cloudy beneath, with gas bubbles. In potato decoction, flaky white sediment. Optimum temperature 37° C. Litmus milk at first acid, then decolorized. Fermentation of glucose, fructose, maltose, galactose, sucrose, dextrin; none of lactose, mannite, inulin. Milk coagulated. Slight evolution of gas with gelatin.

Syringospora Negroni Dodge, n. sp.

Cryptococcus sp. Negroni, Rev. Soc. Argentina Biol. **6**: 648-652, 1930; Rev. Univ. Buenos Aires II, **29**: 360-364, *Figs. 60-62,* 1931.

Isolated from moist intertriginous lesions, once from interdigital mycosis of the toes, once from vulvitis, and once from the epidermis of the male genitalia. [Cases very briefly described and not figured.]

Yeast cells isolated, spherical or ovoid, 4-5μ in diameter, rarely 3-10μ. Rudimentary mycelium present, hyphae short, septate moniliform, blastospores borne in verticils at the nodes and terminally. Yeast cells with a large vacuole and a polar oil globule. Chlamydospores present. No ascospores on Gorodkova agar or on gypsum block.

Growth good on Sabouraud agar and malt agar, colonies confluent, forming a thick, white, moist, creamy layer. Giant colony on malt, 4 cm. in 25-30 days, circular, margins festooned, center slightly elevated, occasionally conic and granular, shining, humid, grayish white, with 4-5 radial furrows. On carrot, growth good, creamy, white, no spores. Malt extract fermented, with a ring and sediment. Litmus milk coagulated and acidified. Glucose, fructose, and maltose fermented; not lactose, sucrose, or galactose. Malt gelatin fermented and liquefied. Optimum temperature 30° C., maximum about 45°, and minimum 12°-15° C.

The following species are placed here from their morphology, but their descriptions are too incomplete to refer here with certainty. It is possible that some of them may belong in synonymy with better described species. The organisms of Hasegawa (p. 282) and of Braafladt (p. 282) may very possibly belong elsewhere.

Syringospora uvae (Pollacci & Nannizzi) Dodge, n. comb.

Cryptococcus uvae Pollacci & Nannizzi in Motta, Atti R. Accad. Fisiocrit. Siena IX, **17**: 636, *1 pl.*, 1925.

Monilia uvae Vuillemin, Champ. Parasit. Homme Anim. 48, 1931.

Isolated from lesions on uvula, sometimes on pillars of fauces.

Cells spherical, 4-8μ in diameter or ovoid, 7.5-9 × 9-10μ, some as high as 15μ. Sprouting polar. Hyphae septate, 2-2.5μ in diameter, alternately branched with glomerules of blastospores at tips.

On Pollacci agar, colonies round, 1-2 mm. in diameter, moist, projecting 0.3-0.4 mm. above substrate, and 0.5-1.0 mm. into it. Radiating hyphae in the upper part of the agar extend 2-4 mm. On malt extract agar, colony gray, dull, smooth, margin smooth. On malt gelatin, colony gray, shining, flat, center slightly elevated, margin somewhat sinuous. In liquid media, floccose colonies form on the surface and settle to the bottom, the liquid remaining clear. No growth on alcohol. On malt extract, a few islets, a thin ring, and sediments. No fermentation; gelatin not liquefied in 57 days at 15° C.

Syringospora Otae (Nannizzi) Dodge, n. comb.

Cryptocococcus Otae Nannizzi, Tratt. Micopat. Umana [Pallacci] **4**: 329, 330, 1934.

Cryptococcus de Burnier (*cas C*) Ota, Ann. Parasitol. Hum. Comp. **2**: 49-51, *Fig. 8*, 1924.

Isolated from a case of epidermomycosis.

On malt agar at 25° C. after one day, cells ovoid or slightly elongate, but often spherical 8 × 5μ, thin-walled, solitary or in pairs, sometimes in short chains or small groups. Cells mostly solitary after a week, walls thicker. On carrot, elongate cells also occur, 15 × 4μ, ends rounded, forming longer chains. Blastospores in simple verticils at the septa, often separating soon leaving one or two which elongate to form branches.

On malt agar, colonies white or slightly yellowish, smooth, margins definite. On malt extract, no ring or pellicle, but sediment formed.

Syringospora Hasegawae, Dodge, n. sp.

Oidium albicans var. Hasegawa, Jap. Jour. Derm. Urol. **28**: 1104-1124, *7 figs.* [86-87], 1928.

Isolated from three ulcers size of hen's egg on lower leg; clinically resembling *Zymonema dermatitidis.* Pathogenic to mice and guinea pig.

Cells 3-6μ in diameter, thick-walled, spherical, some also ovoid or elongate. Chlamydospores 7.5μ. No asci. Conidia at the septa.

Colony, on malt agar, shows characters of a wild bottom yeast. On sugar agar, produces milky white disc with brownish tone. Fermentation negative. Gelatin liquefied. Milk coagulated, with production of acid.

Doubtful Position

Cryptococcus sp. Braafladt, China Med. Jour. **35**: 30-35, 1921.

Isolated from chronic sinuses on breasts of Chinese woman. Breasts removed surgically. In a second case, that of a foreign woman, in which the organism seemed to be the same, there was slight pain in the chest, cough with bloody sputum, dyspnea, and weakness. Cough developed in Chicago before going to the Orient. There is nothing in the article to show which case belongs to the following organism or whether characters of the two strains may not have been confused.

The early colonies form yeast cells only; later clusters of spherical, gram-positive spores attached to long, slender, gram-negative hyphae containing some gram-positive granules. Still later thicker gram-negative hyphae containing spherical or ovoid spores. The transition from yeast cells to hyphae occurs only on solid media and apparently is not reversible.

Colonies on agar, circular, flat, opalescent, 2-3 mm., after 3 weeks beginning to grow aerial hyphae.

On nutrient broth at 37° C., grayish pellicle, heavy sediment at the bottom of the test tube. No pellicle from subcultures.

The first case suggests *Zymonema dermatitidis* or *Atelosaccharomyces hominis.*

BLASTODENDRION

Blastodendrion Ota, Derm. Woch. **78**: 216-264, 1924; Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, **2**: 129-146, 1925.

?Oidiodendron Robak, Nyt. Mag. Vidensk. **71**: 243-255, 1932.

The type species is *Blastodendrion Krausi* Ota.

Colony creamy, thin, beginning from the germination of thick-walled blastospore, forming a dendroid mass by sprouting, either bipolar or multipolar, rarely cruciate; blastospores polymorphous, the lacrimiform or pyriform type predominating; pseudomycelium more or less developed, little branched, less easily dissociable than in related genera, forming dendroid masses with ascending branches parallel or suggesting the branching of sporophores in *Penicillium*, cells mostly elongate, pyriform, hyhpae terminated by a chain of lacrimiform blastospores or by a long slender filament; verticils occasionally present, formed of lacrimiform blastospores.

Found in a variety of conditions, the most conspicuous being a group on moist skin and about nails. This whole group needs further study to differentiate it both morphologically and culturally from related groups. Langeron & Talice made a good beginning but much more needs to be done.

Key to Species

Pellicle produced on liquid media.	
Cells 5 × 10μ.	*B. Krausi.*
Cells 2-4μ.	*B. intermedium.*
No pellicle on liquid media.	
Glucose, fructose, and maltose fermented.	
On mucous membranes.	*B. Pinoyi.*
On moist folds of skin.	*B. Favrei.*
Only glucose fermented.	*B. elongatum.*
Sucrose fermented.	*B. Kayongosi.*
Galactose fermented.	
Cells 50-60μ long.	*B. cutaneum.*
Cells up to 10μ long.	*B. gifuense.*

Blastodendrion Krausi Ota, Derm. Woch. **78**: 229-230, 1924.

"Pferdehefe II."

In 24-hour-old cultures may be found rudimentary branched mycelium of round or long, ovoid cells not easily breaking apart, cells 5 × 10μ, many small fat granules. In 3-day cultures, cells 15μ long. Mycelial habit retained up to a month, fat drops peripheral to a central vacuole. On carrots, morphology is similar, but with much longer cells.

On malt extract, a pellicle appears and on inner wall of tube, cells 10-20 × 3-4μ, with abundant branching. Also branching forms found in sediment.

Blastodendrion intermedium Ciferri & Ashford, Porto Rico Jour. Publ. Health & Trop. Med. **5**: 91-105, *4 pls.*, 1929.

Isolated from the human intestine in a case of sprue, but not pathogenic for rabbits, and since *Syringospora psilosis* (*Monilia psilosis*) was also present in abundance, probably not connected with sprue.

Cells spherical to ellipsoid or ovoid, rarely of other shapes, normally 2-4μ, with small cells 1-1.5μ and giant cells up to 10μ (Fig. 52).

Giant colonies white, with one or more central craters, margin lobular, and denticulate (type II of Will). On liquid media, pellicle, ring, and sediment present. Ferments glucose, fructose, sucrose, maltose, trehalose, melitose and galactose; fails to assimilate lactose and all alcohols except glycerol; assimilates peptone and asparagin, ammonium sulphate slightly, but not nitrites or nitrates. Gelatin not liquefied.

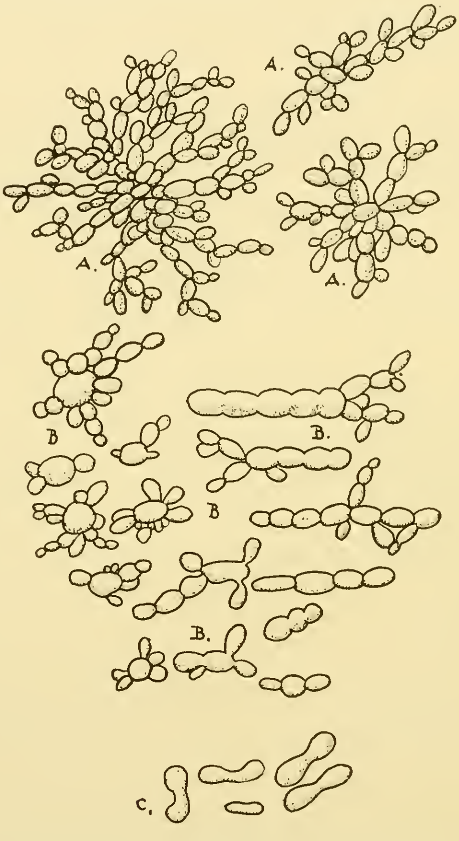

Fig. 52.—*Blastodendrion intermedium.* *A,* mycelium and blastospores; *B,* actively sprouting blastospores; *C,* germination of blastospores.

Blastodendrion elongatum Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 17-18, 1926.

One of the organisms isolated from stools of patients suffering from true dysentery in Belgian Congo. Also isolated in one case of European resident suffering from enteritis.

After 3 days in potato decoction, spherical cells, about 6μ in diameter, or ovoid cells, 8 × 4μ, containing large vacuoles, also long narrow cells, 3 × 12-23μ. Cell groupings do not give rise to simple filaments. Blastospores spherical, ovoid, or elongate at the septa.

On Sabouraud agar at 37°, colony dull white, finally yellowing at the center, with radial folds; margin lobed, and numerous verruciform projections into medium. On gelatin stab, appearance at surface the same, but in depth, numerous small granules. In potato decoction, white lumpy sediment which breaks up somewhat on shaking. Optimum temperature for growth 37° C. Litmus milk at first acid, then alkaline. Glucose fermented; fructose, sucrose, and dextrin slightly fermented; no fermentation of maltose, galactose, lactose, mannite, or inulin. Gas evolution with gelatin.

Blastodendrion Kayongosi Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 20-21, 1926.

Isolated from a grayish white covering on tongue and tonsils of five-year-old boy in Belgian Congo, which prevented him from eating. Elevation of body temperature also observed. Scraping and application of tincture of iodine caused amelioration of symptoms. Patient not seen again.

In scrapings, blastospores spherical, 2-3μ in diameter, others ovoid or elongate of analogous dimensions. After 3 days' growth in potato decoction at 37°, cells mostly rounded with an oil droplet, maximum diameter 6μ. After 30 days, hyphal forms appear, much branched, elongate cells averaging 7 × 2.5μ. Branches sometimes reduced to a single spherical or elongate cell. Optimum temperature for growth 37° C.

On Sabouraud agar, colony round, dull, white with center later yellowing and wrinkling margin with radial striations which cause fine indentations. On gelatin stab, surface of same aspect as on Sabouraud agar. Fine points of growth along the stab, with displacement of medium. In potato decoction, flaky sediment which separates on shaking, no pellicle. Glucose, fructose, maltose, galactose, and sucrose fermented, not lactose, mannite, dextrin, or inulin. Slight acid production in milk, no clotting. Gelatin not liquefied, but gas produced.

Blastodendrion Pinoyi (Castellani) Langeron & Talice, Ann. Parasitol. Hum. Comp. 62, 1932.

Endomyces Pinoyi Castellani, Lancet **1**: 15, 1912; Brit. Med. Jour. **2**: 1208-1212, 1912.

Monilia Pinoyi Castellani & Chalmers, Man. Trop. Med. ed. 2, 826-827, 1913.

Myceloblastanon Pinoyi Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Odlund & Hoffstadt, Arch. Derm. Syphilol. **20**: 335-338, 1929, give good description and drawings of their case of *Monilia Pinoyi* infection of the penis and vagina (Fig. 53).

Originally isolated from sputum in case of bronchomycosis.

Acidification and fermentation with glucose, fructose, and maltose. Milk not clotted, coagulated serum, and gelatin not liquefied.

Permanand (1922) gives the following cultural characters. Colonies dull white, smooth with an ivory-like surface, sticky, dense, not adherent to the medium.

Lasseur & Servet (1922) describe cultures as follows. Opaque, white elevated and round on Sabouraud maltose. On gelatin, velvety, thick, elevated, pure white. Growth poor on potato and turnip. Acidification and fermentation with glucose, fructose, and maltose, not with other sugars. Growth on coagulated serum poor, no liquefaction. Gelatin not liquefied. Organism gram-positive.

Blastodendrion Favrei (Ota) Dodge, n. comb.

Levure de Favre Ota, Ann. Parasitol. Hum. Comp. **2**: 51, 1924.

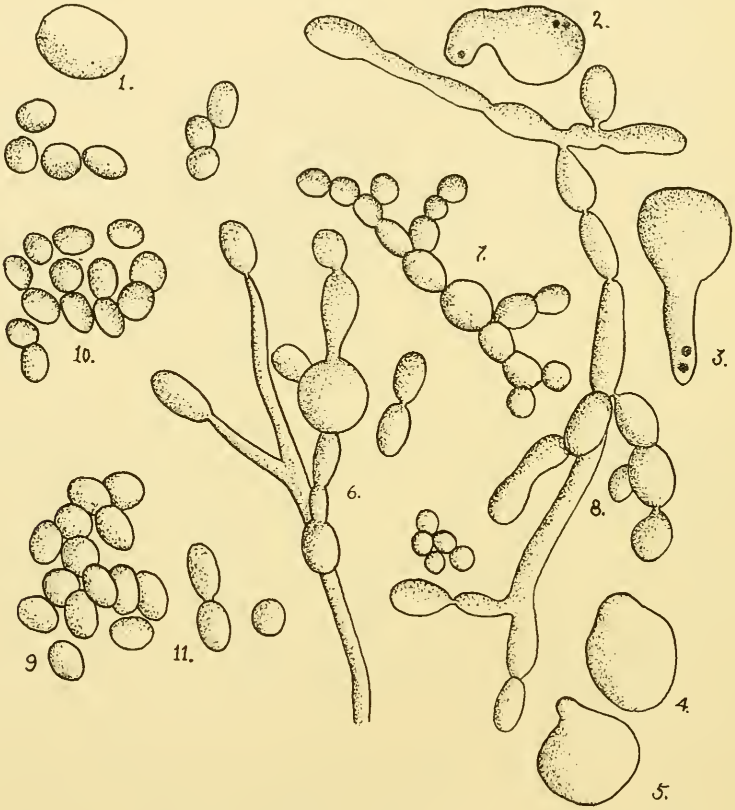

Fig. 53.—*Blastodendrion Pinoyi.* (After Odlund & Hoffstadt 1929.)

Myceloblastanon Favrei Ota, Ann. Parasitol. Hum. Comp. **3**: 181-184, *1 fig.*, 1925.

Cryptococcus (*Mycocryptococcus*) *Favrei* Pollacci & Nannizzi, I Miceti Patog. **9**: 83, 1929.

Candida Favrei Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

First case cited, Favre & Ota, C. R. Soc. Biol. **88**: 222-224, 1924.

Isolated from pruriginous dermatitis of inguinal and axillary folds. Subcutaneous or intraperitoneal injections pathogenic to rabbit and guinea pig.

Morphology on carrot: cells spherical, ovoid, ellipsoid, often elongate, isolated or in twos, occasionally agglomerated in larger number. In deeper layers cells are in chains, 2.5-3.5 × 10-20μ, developing by budding, chains branched, cells larger at one end. Same, but less pronounced, on glucose agar, malt agar, or bouillon. True mycelium in 15 days on carrot or in potato decoction. Hyphae slender, 1-2μ, septate as in *Mycoderma lactis.*

Maximum temperature for growth 50°-52° C., optimum temperature 35°-40° C., no growth at 12° C. In 12 days at 25° C., giant colony attains size of one franc piece.

On Pollacci agar, colony irregular, white to yellowish, smooth, moist. Colony on malt agar at 25° C., for 24 hours, round, sometimes elliptic or oval, 3-7 cm. Refractive granules fuse on fifth day. Giant cells 10μ with numerous fatty granules. Growth on carrot similar. In malt extract, a grayish white sediment appears in 24 hours, but no pellicle or ring in 25 days. After a month, some cells tend to creep up the sides of the tube. No spores formed on Gorodkova agar, carrot, or plaster block. The giant colony appears grayish white, humid, brilliant, margin rounded and distinct, rays from center. Organism does not invert sucrose; moderate fermentation of glucose, fructose, and maltose, none of other sugars. Gelatin not liquefied.

Blastodendrion cutaneum (Ota) Dodge, n. comb.

Myceloblastanon (*Mycelorrhizoides*) *cutaneum* Ota, Derm. Woch. **78**: 232-234, 1924.

[*Oidiomyces unguium*] Frei, Arch. Derm. Syphilis **129**: 404-433, 1921, organisms of Fabry, München. Med. Woch. **65**: 1557-1558, 1917; Ibid. **66**: 321, 1918; Berendsen, Arch. Derm. Syphilis **126**: 751-763, 1919; Samson, Derm. Woch. **76**: 473-481, 1922.

In 24-hour-old cultures on malt agar at 25° C., cells are mostly ovoid, thin-walled with large vacuole and very small oil globule. Cells, sometimes in chains, usually 2-5μ (sometimes 9μ) in diameter, 50-60μ long, 7μ in diameter at rounded end and 3μ at point. In 10 days, cell chains have broken up, cell walls are thickened, and large fat granules appear. In 30 days, they have broken down into ovoid forms, interior with large vacuole and fat drops. On carrots, mycelium penetrates substrate as slender cells, 2-3μ in diameter; hyphae dichotomous. No pellicle on malt extract. Fermentation with glucose, fructose, mannose, galactose and maltose only.

Var. **Fujii** Dodge, n. var.

Myceloblastanon cutaneum var. *I.* Fujii, Jap. Jour. Derm. Urol. **31**: 959-983, *15 figs.* [71-72], 1931.

Organism isolated from an infection on the hand of a Japanese farmer. Three years before the middle finger became grayish in color and translucent, slightly swollen. Surface dull, edematous, erythematous, then cracked and became vesiculose with little pruritus. Organism injected intraperitoneally into mice, was fatal to most within 72 hours.

Cells 15-13-10 × 7.5-5.8μ in diameter, spherical, ovoid, or polyhedral. Pyriform cells show diameter of 3μ at smaller end. Cell wall thin. On Gorodkova agar, hyphae 3-4.5μ in diameter, transparent, flexuous, up to 45μ long. Blastospores showing nucleus and vacuoles 4μ in diameter.

On Sabouraud glucose agar after 10 days, colony circular, 1.5 cm. in diameter, surface flat, margin thinning, center slightly elevated, moist, grayish yellow. On malt agar, in 10 days colony circular, 1.5 cm. in diameter, yellowish white, umbilicate, shining. By the twentieth day 2 cm. in diameter with radiating rays which become closer together with age, surface moist, center gradually depressed, medium not discolored. On glucose gelatin, at tenth day colony round, 1 cm. in diameter, smooth, moist, sticky, grayish white. On twentieth day colony same size with margins denticulate. On malt extract in 10 days, liquid cloudy and sediment present; no pellicle or ring mentioned. Acid production with fructose and mannose. Fermentation of galactose, arabinose, xylose, rhamnose, and maltose. None with glucose(!), lactose, raffinose, inulin, mannite, peptone, or starch. Gelatin not liquefied.

Blastodendrion gifuense (Taniguchi) Dodge, n. comb.

Myceloblastanon gifuense Taniguchi, Jap. Jour. Med. Sci. xiii, Derm. Urol. 1: 74-94, *Pls., 1-2,* 1926.

Producing interdigital blastomycosis among paper workers, locally known as *sadare,* in the province of Gifu. In the manufacture of *mino* paper, the workers keep their hands in water practically the whole day. Paper made from bark of *Broussonetia papyrifera* Vent. or *Quercus glandulifera* Blume, bark bleached with CaOCl, washed thoroughly with water, then a maceration of the root of *Hibiscus japonicus* Miq. or *H. Manihot* L. is added for the slime which holds the paper fibers together and makes it suitable for umbrellas. In a village of 50 workers examined, of 30 infected, most had used local remedies, juices of plants. Also some attempt had been made at the factory by dipping the hands in $CuSO_4$ solution or $HgCl_2$, the former ineffective, the latter effective in 1:10,000 dilution. Organism was isolated from raw root of *Hibiscus,* from the preparation used in paper making, as well as from the paper makers. Pathogenic for mice.

Cells ovoid, thick-walled, 2 × 4-3 × 5μ, up to 10μ long. Optimum temperature 25°, growth very slow at 37° C. No asci seen.

On glucose and malt agar, growth good, colonies round, yellowish white, smooth, margins sharp, moist, shining, center slightly elevated, deeper colored, whole colony browns in drying out. On carrot, growth good, yellowish or clay color. On malt extract, turbid in 2-3 days, with sediment, but no pellicle or ring. Ferments maltose, mannose, fructose, glucose (one strain fermented galactose and one strain raffinose) as does *Myceloblastanon cutaneum* (Fabry, etc.).

Blastodendrion Arzti Ota, Derm. Woch. **78**: 232-234, 1924.

On malt agar, cells ovoid or long ellipsoid, 2-6 × 3-10μ, others 2-3 × 30-60μ with rounded ends, one end usually rather thicker than the other, arranged in loose chains; other cells 10-20 × 3-5μ with pointed ends; round cells have one or two fat drops, long cells, many small ones. In hanging drop, branching chains are formed which cling together for several days.

Gas with levulose, sucrose, and raffinose only.

Myceloblastanon (Mycelorrhizoides) Gruetzii Ota, Derm. Woch. **78**: 226, 264, 1924.

This is proposed as a nomen nudum.

Blastodendrion erectum Camargo, Agentes Etiologicos do Sapinho 60, 1934 (nom. nud.).

REDAELLIA

Redaellia Ciferri, Arch. Protistenk. **71**: 424-428, *Fig. 3,* 1930.

The type species is *Redaellia elegans* Ciferri.

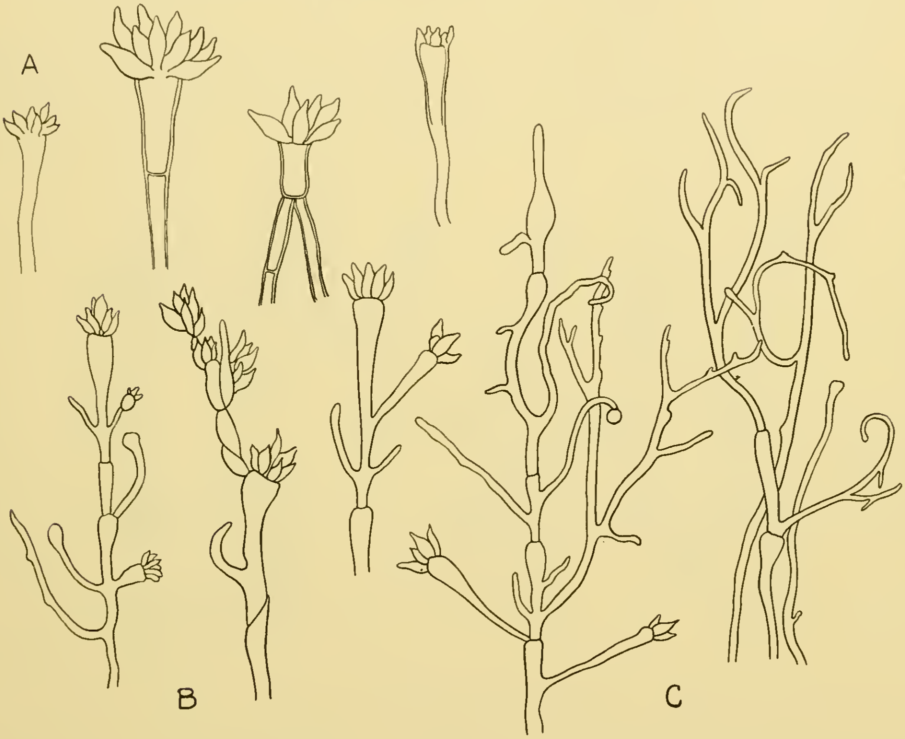

Fig. 54.—*Redaellia elegans* Ciferri. (After Ciferri 1930.)

Colony growth slow, elevated, cerebriform, irregularly convoluted, hyphae hyaline, septate, branched with many fusiform blastospores at the tips; blastospores germinating either by sprouting or by hyphae.

Only a single species of doubtful pathogenicity has been referred here.

Redaellia elegans Ciferri, Arch. Protistenk. **71**: 424-428, *Fig. 3,* 1930.

Isolated along with *Epidermophyton rubrum* from a case of tinea axillaris in Santo Domingo.

Blastospores apical, 1-20μ, usually 3-10μ, on the top of a slightly inflated cell, more or less fusiform. Ciferri states pyriform, but his drawings show uniformly fusiform blastospores, 6-8 × 2.5-3μ, which he was unable to germinate in hanging drop; gelatin not liquefied, sugars not fermented (Fig. 54).

I am doubtful whether this genus really belongs to the Eremascaceae. Evidently a contamination, suggesting a primitive Basidiomycete or perhaps an unreported member of the Tulasnellaceae which grew in the cultures. The drawings do not suggest any other filamentous yeast. The mycelium is largely of the raquet type, if the drawings are correct.

MYCOTORULOIDES

Mycotoruloides Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 48-54, 1932.

The type species is *Mycotoruloides triadis* Langeron & Talice.

Colonies creamy, thick, convex, beginning by bipolar sprouting of a blastospore followed by progressive branching of the pseudomycelium. Blastospores spherical or ovoid, arranged in verticils, arising at the apical portion of the pseudomycelial cells, no terminal chains of cells. Pseudomycelium formed of short cells, each cell producing a verticil of blastospores at its apex. The verticils are less regularly spaced than in *Syringospora* and are usually compound, producing an ovoid mass of blastospores whose long axis is more or less perpendicular to the main axis of the pseudomycelium (Fig. 55). Some branches develop more than others, giving an irregular appearance. Occasionally a branch grows out and is terminated by short chains from its terminal verticil. Gelatin not liquefied.

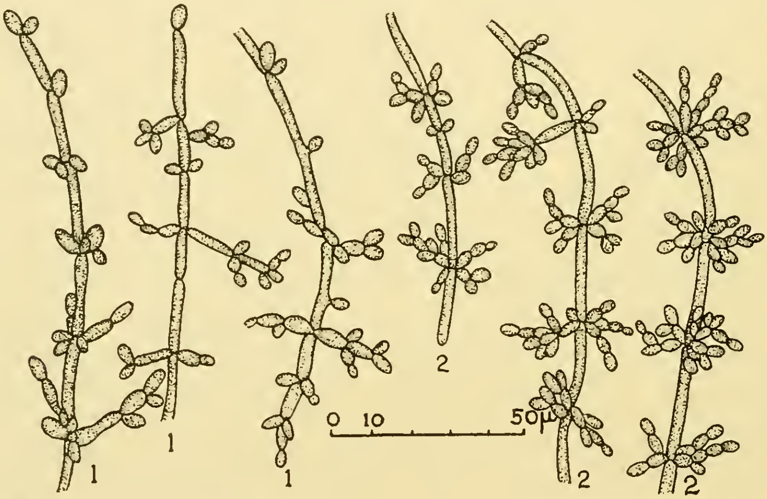

Fig. 55.—*Myeotoruloides.* *1,* young mycelia; *2,* mature mycelia. (After Langeron & Talice 1932.)

Key to Species

No pellicle on liquid media, from nails. *M. unguis.*

Pellicle or ring on liquid media.

  Glucose, maltose, and sucrose fermented, galactose acidified, gelatin not liquefied, from chronic ulcers of tongue. *M. argentina.*

Glucose and maltose fermented.
 Gelatin liquefied, no action on galactose, from lungs. *M. triadis.*
 Gelatin not liquefied, acid produced on galactose, from tongue. *M. aldoi.*

Mycotoruloides argentina (Vivoli, Avellaneda & Bardessi) Dodge, n. comb.

Monilia argentina Vivoli, Avellaneda & Bardessi, Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán **7**: 239-277, *37 figs.*, 1932.

Geotrichoides tumefaciens Talice & Mackinnon p.p., Reunión Soc. Argentina Patol. Reg. del Norte en Santiago del Estero **8**: 161, 162, 1933.

Ulcerous lesions on tongue, complicated by syphilis. Biopsy showed filaments 20-60 × 2μ, unbranched, septate. Autopsy showed nodular lesions in lungs. Pathogenic for rats, rabbits, and guinea pigs.

On Sabouraud agar, yeast cells spherical or ovoid, 4-7μ in diameter and hyphae unbranched, terminal cell somewhat clavate, septate, up to 60μ blastospores polymorphic; coremia frequent.

Colonies shining, pasty, not adherent, confluent, margins irregular with fine radiating hyphae. On malt agar, colony slightly granular, yellow. On Pollacci agar, colony spherical, at first yellowish white, becoming thick, rugose, dry. On potato glycerol, colony thick, grayish white; on carrot glycerol, colony about 2 mm. thick, white rugose, dull, partly covered by a fine dark brown layer; on beets, white pasty colony which assumes a rose tint. On gelatin, growth good; on coagulated serum, growth poor; on both, colony white with some hyphae. In malt extract, or Raulin's liquid, white powdery sediment, no ring or pellicle. On sugar broths, thin white pellicle; glucose, maltose, and sucrose fermented, slight acidity in fructose, galactose, and lactose but at the end of a month all sugar broths have become alkaline. Milk coagulated, gelatin and serum not liquefied.

Mycotoruloides unguis (Weill & Gaudin) Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 50, 1932.

Spicaria unguis Weill & Gaudin, Arch. Méd. Exp. **28**: 461-463, *Pl. 12,* 1919.

Monilia unguis Vuillemin, Champ. Paras. Homme Anim. 85, 1931.

Found on nails in two cases of onychogryposes with splitting of nail into white and yellow layers.

Mycelium slender, 1.5μ in diameter, septate, sometimes closely entangled and bearing spherical or ovoid blastospores. Mycelium branched, septate with septa 3-6μ apart. Verticillate pyriform buds at level of the septa give rise to verticillate chains of blastospores which are hyaline, rounded, or pyriform, 3 × 4-5μ.

Organism grows on all the usual substrates, best at 37° C. On Sabouraud maltose agar, growth fleshy, white [or yellowish if the maltose is colored], convoluted. On potato, colony humid, grayish, 2-3 mm. thick, chalky on desiccation. Growth vigorous on carrot. In giant colonies, growth is 10-12 mm. in 10 days, dirty white, brilliant with densely twisted masses of hyphae about 1.5 cm. thick. In Raulin's liquid a scanty white granular sediment appears at the bottom of the tube.

Mycotoruloides triadis Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 48, 1932.

Monilia sp. Brocq-Rousseu, Guilliermond & Cilleuls, Ann. Parasitol. Hum. Comp. **5**: 48-62, 1927.

Isolated from an infection of the lung, clinically suggestive of tuberculosis. After the diagnosis was established, patient cured in a short time by potassium iodide. Pathogenic to guinea pig and rabbit.

On malt extract developing as a yeast, cells spherical 2.8-8μ in diameter, or ovoid, 4-8 × 6-10μ, united in small groups, then developing a septate, branched mycelium of normal slender cells and swollen cells. Giant cells 10.5-18μ sometimes up to 40μ in diameter. Mycelium early appearing on malt extract agar, yeast cells predominant in the pellicle.

On agar, colonies white, almost transparent, thick. On Sabouraud agar similar, but colony whiter and more abundant, confluent. On malt agar, yeast decoction agar, and Gorodkova colony humid and white. On malt agar after 15 days, colony circular, yellowish white, moist, center granular reticulate, margin smooth with a few radial furrows, composed of large lobes. After 2 months, center is thicker, mesenteroid in appearance, surrounded by a broad smooth zone with radial furrows, margin thinner and finely festooned. No change of color in neutral red agar, no blackening in lead subacetate agar; on litmus sucrose agar, slight reddening of the medium, soon turning back to blue. On litmus lactose agar, slight growth, no change of color. On carrot and potato, colonies white and confluent. On gelatin, colony creamy white, growth slow. In gelatin stab, growth conic above, suggesting a pipe cleaner. On coagulated serum, growth slight. On malt extract, whitish sediment with fermentation, then a ring forms and about the fifteenth day spreads to cover the surface, brownish yellow but no true pellicle. In yeast decoction, grayish islets which coalesce to form a complete delicate pellicle. No indol on peptone. Milk coagulated in 12-15 days, curd digested, no acidity developed. Albumin digested. Starch not hydrolyzed. Sucrose inverted; glucose, fructose, maltose, and dextrin fermented. No action on galactose, lactose, and raffinose. Liquefaction starts on the tenth day and is completed in 2 months.

Mycotoruloides aldoi (Pereira Filho) Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 49, 1932.

Monilia aldoi Pereira Filho, Jour. Trop. Med. Hyg. **27**: 8-10, 1927.

Candida aldoi Castellani & Jacono, Jour. Trop. Med. Hyg. **36**: 317, *Fig. 46*, 1933.

Isolated from a case of hypertrophy of the tongue with white spots appearing. Intraperitoneal injection caused death of rabbit in 3 days, intravenous injection caused death of guinea pig in 2 days.

Organism gram-positive. Mycelium reported but no ascospores.

In culture gave small, smooth white colonies composed mostly of yeast cells with some mycelium. On "yeast medium" (equal quantities of yeast and 3% glucose; solution autoclaved at 115° C. for 15 minutes) gave rough colonies and mycelium. In broth, a slight turbidity appears with a white powdery deposit. In peptone water, no turbidity, but white flakes on walls and at bottom. No acid formation here or in milk. In yeast extract, turbidity and pellicle at sides of tube. Glucose, fructose, and maltose fermented. Acid formation with sucrose and galactose. No action with lactose, mannite, dextrin, spores (Fig. 56). Gelatin not liquefied.

MYCOCANDIDA

Mycocandida Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 56-58, 1932.

The type species is *Candida mortifera* Redaelli.

Colonies creamy, sometimes thick, more often thin, flat, iridescent, transparent at first, gently sloping from the center, sometimes coremia present; colonies beginning by bipolar sprouting; blastospores appearing late, dimorphous, ovoid or elongate, the latter predominant, much less numerous than in the preceding genera. Pseudomycelium well developed, highly branched (suggesting a fir tree), hyphae ending in a group of blastospores, a short chain, or a single elongate cell. Verticils not developed, the apical portion of a pseudomycelial cell not producing more than two opposite blastospores (Fig. 56). Gelatin not liquefied.

Key to Species

Colony yellowish, becoming rose color.	*M. rosea.*
Colony not becoming rose color.	
Maltose fermented, cutaneous lesions.	*M. Skutetzkyi.*
Maltose not fermented, intestinal tract.	*M. parapsilosis.*
Action on maltose unknown, nails.	*M. onychophila.*

Mycocandida rosea (Zenoni) Dodge, n. comb.

Oidium roseum [*non liquefaciens*] Zenoni, Lo Sperimentale **66**: 33-66, 1912.

Monilia rosea Castellani & Chalmers, Man. Trop. Med. ed. 2, 829, 1913.

Myceloblastanon roseum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Candida rosea Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Isolated from a fatal case of hepatitis. Pathogenic for rabbits.

Colony yellowish, rounded, granulose, waxy, shining. On agar after 12-15 days, there is a definite odor and distinct rose coral color. In plain broth, floccose sediment. In brain broth, liquid becomes turbid with white powdery sediment and yellowish white flocci. Gelatin not liquefied.

Mycocandida Skutetzkyi (Ota) Dodge, n. comb.

Cryptococcus Skutetzkyi Ota apud Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 331, 1934.

Cryptococcus de Skutetzky Sasakawa, Centralbl. Bakt. I, **88**: 273, 1922; Ota, Ann. Parasitol. Hum. Comp. **2**: 53-55, *Fig. 10*, 1924.

Isolated from cutaneous lesions, case never published.

Yeast cells spherical, 5μ in diameter, or ovoid with some raquet mycelium, producing single blastospores at the septa. Mycelium not highly developed, hyphal cells 5μ in diameter, walls somewhat thickened.

On malt agar, colony grayish or yellowish, smooth, center granular, with slight rays or fine folds. On malt extract, producing a thick grayish ring with sediment. By Lindner method, reported to ferment glucose, fructose, mannose, galactose, and maltose, but no action on sucrose, lactose, or raffinose.

Mycocandida parapsilosis (Ashford) Dodge, n. comb.

Monilia parapsilosis Ashford, Am. Jour. Trop. Med. **8**: 518, 1928.

Candida parapsilosis Camargo, Agentes Etiologicos do Sapinho 58, 1934.

Nonpathogenic to guinea pigs and rabbits.

Produces growth of fir tree shape along gelatin stab. Maltose not fermented. Gelatin not liquefied.

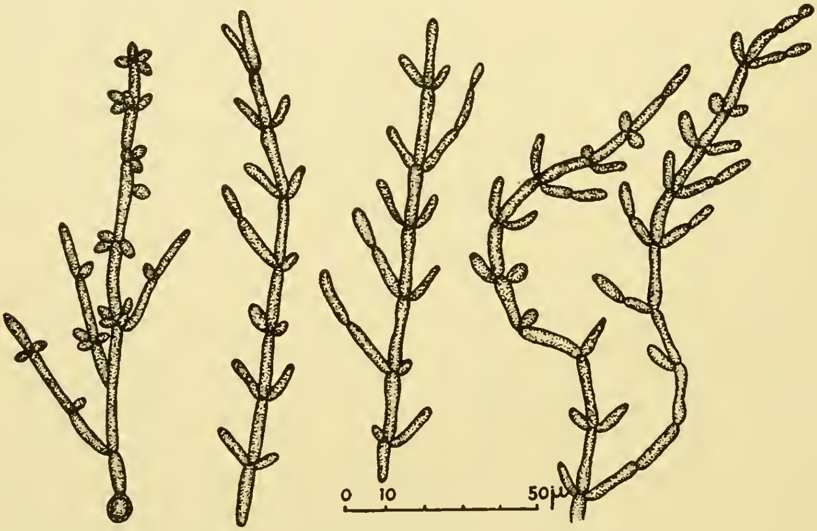

Fig. 56.—*Mycocandida*, showing branching and reduced verticils. (After Langeron & Talice 1932.)

Mycocandida onychophila (Pollacci & Nannizzi) Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 58, 1932.

Monilia onychophila Pollacci & Nannizzi in Marengo, Archivi di Biol. **3**: 4:25-36, *2 figs.*, 1926.

Mycotorula onychophila Ciarrocchi, Giorn. Ital. Derm. Sifilol. **74**: 415-429, *3 pls.*, 1933.

Isolated from paronychomycosis. Probably organism of Connor (1933) should be referred here.

In pus cells spherical hyaline 3-5μ, same cells seen in nails.

Cells spherical or slightly ovoid uniguttulate, solitary or in chains, mostly 3.5-5μ in diameter; in older cultures mycelium present. Somewhat sparingly branched, septate, hyaline, 2-3μ in diameter, branches cylindric, terminal cell clavate, bearing a chain of blastospores, 3-8 cells long; blastospores spherical, ellipsoid, or citriform, uniguttulate, hyaline, 3.5-6μ in diameter, or 3.5-6.5 × 3-5μ.

On Sabouraud agar, colony creamy, surface smooth and shining, whitish tending to yellow in age. On Pollacci agar, creamy, but the surface is slightly granular, yellowish becoming brownish. On potato and carrot, creamy whitish, less shining than on agar media. On Raulin's liquid medium at 20° C., slight pellicle and ring with slight sediment. On broth, ring more highly developed, pellicle not reported, sediment without turbidity, glucose and fructose fermented (other sugars not reported); gelatin liquefied.

Mycocandida mortifera (Redaelli) Langeron & Talice, Ann. Parasitol. Hum. Comp. **10**: 58, 1932.

Candida mortifera Redaelli.

Isolated from the lungs.

Mycelium, septate, 10-20 × 2-2.5μ; blastospores spherical or ovoid, in chains of 3-6 cells, 4-5μ in diameter; chlamydospores abundant in old cultures.

On carrot agar, colony creamy, light yellowish, convex, margins sinuous. On carrot, colony elevated, center convex, margins lobed, white or slightly cream colored, opaque. Giant colony on malt gelatin (30 days) plane, white or slightly yellowish with three concentric zones and denticulate margins. On malt extract, an incomplete, irregular, semitransparent ring, no pellicle and slight, floccose, powdery sediment. On glucose broth, no ring or pellicle, slight sediment. Glucose, fructose, sucrose, mannite, galactose, and lactose fermented; maltose not fermented; no reduction of methylene blue; milk not clotted; gelatin liquefied.

PSEUDOMONILIA

Pseudomonilia Geiger, Centralbl. Bakt. II, **27**: 97-149, *2 pls., 4 figs.*, 1910.

The type species is *Pseudomonilia albomarginata* Geiger.

Cell shape variable in young cultures, sprout cells in old cultures; more or less branched mycelium formed of elongate sprout cells but no true septation; giant cells common in old cultures. Pellicle well developed, very little sediment; no ascospores, no alcoholic fermentation, sugars variously assimilated; gelatin not liquefied.

Key to Species

Milk not coagulated.	*P. matalensis.*
Milk coagulated.	
Acid formed in lactose.	*P. inexpectata.*
Acid formed in sucrose.	*P. alessandrina.*

Pseudomonilia matalensis (Castellani) Dodge, n. comb.

Oidium matalense Castellani, Lect. on the Higher Fungi in Relation to Human Pathology. R. Coll. Phys. 1915; Castellani & Chalmers, Man. Trop. Med. ed. 3, 1096, 1919.

Mycoderma matalense Brumpt, Précis Parasitol. ed. 3, 1084, 1922.

Pseudomycoderma matalense Ciferri, Arch. Protistenk. **71**: 436-443, 1930.

Geotrichum Matalense Castellani, Jour. Trop. Med. Hyg. **35**: 278-279, *3 figs.*, 1932.

Isolated from ulcers and from sputum of cases of bronchitis in the tropics (Ciferri 1930).

Mycelium abundant on agar, little branched, septate, 2-5μ in diameter, generally 3-4μ, blastospores sprouting, 5-15 × 2-4μ, generally 10 × 3μ, isolated or sprouting to form chains.

Colony effuse, white on agar and gelatin. On liquid media, producing islets promptly white, cottony above, mucus, yellowish below, finally becoming rose violaceous pellicle, practically no sediment. Sucrose not inverted, milk slightly acidified, no fermentation of sugars, no liquefaction of gelatin.

There seems little to distinguish var. *Chapmani* Castellani, Jour. Trop. Med. Hyg. **35**: 278-279, 1932.

Pseudomonilia inexpectata (Mazza, Niño & Egües) Dodge, n. comb.

Monilia inexpectata Mazza, Niño & Egües, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **5**: 284-288, 1930.

Mycocandida inexpectata Talice & Mackinnon, Reunión Soc. Argentina Patol. Reg. del Norte in Santiago del Estero **8**: 164, 1934.

Isolated from the drops of pus expressed from inflammatory processes involving the fingers, particularly around the nails, in a woman, a native of Buenos Aires, Argentina. Ordinary medicaments of no avail. Intraperitoneal injection to guinea pig and mouse produced abscesses.

On Sabouraud glucose agar at 37° C., or room temperature, in 24-48 hours, abundant growth, colonies cream white, dry in appearance, opaque surface, not adhering to substrate; after 5 days several colonies about 1 cm. in diameter, center smooth, elevated, margins deeply folded. Growth similarly abundant on simple agar and broth media. On agar, slight growth in 24 hours. On potato with 8% glycerol, good growth in 24 hours, colony cream-colored, dry in appearance; no pigmentation of medium. On Drigalski-Conradi medium, colony grows without modification of medium at first, then slight evolution of gas. On Gougerot gelatin medium, growth good. On coagulated human serum, organism grows with digestion of the part of medium disturbed by puncture. In Sabouraud glucose broth, turbidity and sediment, with formation of creamy white pellicle which ascends walls of tube. In plain broth, uniform turbidity and sediment after 24 hours. In Raulin's liquid, turbidity, sediment, and pellicle ascending sides of tube. No fermentation of sugars. Acid produced in maltose, lactose, dextrin, and glucose. No indol. Milk coagulated in 24-48 hours. Gelatin not liquefied.

Indistinctly positive or negative to Gram's stain; with Guéguen's mixture preparation colored intense blue with tiny points of brick red, probably corresponding to fat droplets stained with the Sudan II. With "panoptic" stain, yeast elements blue, hyphae part blue and part purplish red, giving a laminated appearance.

Pseudomonilia alessandrina (Panayotatou) Dodge, n. comb.

Monilia alessandrina Panayotaton, Jour. Trop. Med. Hyg. **33**: 17-18, 1930.

Isolated from the mucopurulent sputum in a case of bronchitis. Medicated with KI. Intravenous injection into rabbit caused generalized infection and finally death. Organism reisolated.

Cells yeastlike, 3-4μ in diameter. Gram-positive.

On Sabouraud agar, abundant white growth. Wrinkled colonies on beef agar. Pellicles formed in maltose and sucrose. Acid formation with glucose? ["gelose"], maltose, sucrose, dextrin, raffinose, galactose, and dulcite. No fermentation of any medium. No indol or H_2S formed. Milk acidified and coagulated on fourth day. Coagulated serum and gelatin not liquefied.

Doubtful Position

The following species have been so vaguely described that I have not been able to refer them even doubtfully to genera of the Eremascaceae Imperfectae, or I have been unable to locate a copy of the original descriptions.

Monilia Botrytis Vuillemin, Champ. Parasit. Homme Anim. 87, 1931.

Botrytis sp. Auche & LeDantec, Arch. Méd. Exp. I, **6**: 853-861, 1894.

Botrytis pyogenes Fayod, 1894.

Imperfectly described and not easy to place. Cultures lost. Beurmann & Gougerot, Arch. de Parasitol. **15**: 88, 1910, think it is a *Sporotrichum*.

Candida pinoysimilis Castellani, Jour. Trop. Med. Hyg. **36**: 312, *Fig. 37*, 1933.

Cryptococcus pinoysimilis Castellani, Med. Press Circular **136**: 441, 1933.

Isolated from the surface of a blastomycetic, verrucoid lesion, pathogenicity doubtful.

Cells spherical or ovoid, 3.5-7μ. Some hyphae noted.

On glucose agar, smooth, white. Litmus milk made slightly alkaline, gelatin and serum not liquefied. Sugar fermentation doubtful [reports fermentation of glucose, fructose, and maltose in text, denies it in accompanying table]. Acid produced in glucose, fructose, sucrose, lactose, glycerol, inulin, and perhaps xylose.

Saccharomyces intertriginis Touraine-Desvaux, Contr. étude des épidermomycoses à levures . . . Thèse Fac. Méd. Paris **203**: 1-44, 1923.

[Unnamed organism] Gougerot & Gancéa, Bull. Soc. Derm. Syphiligr. **25**: 335-339, 1914; Hudelo & Montlaur (1914).

Cryptococcus de Gougerot et Gancéa Ota, Ann. Parasitol. Hum. Comp. **2**: 43-44, 1924

Cryptococcus Gougeroti-Ganceae Ota apud Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 309, 310, 1934.

Isolated from an interdigital mycosis of the feet, persistent over 2 years under a variety of treatments. Intravenous injection into rabbit produced rapidly fatal septicemia or pyemia with metastatic abscesses and generalized peritoneal infection.

Hyphae, pseudomycelium, and sprout cells present.

Colonies white, spreading, creamy, shining, smooth or with center slightly folded and surrounded by a smooth zone.

Monilia Montoyai Castellani & Chalmers, Man. Trop. Med. ed. 2, 1514, 1913 (nomen nudum).

Isolated from red pinta.

Monilia pulmonalis (Plaut) Sartory, Champ. Parasit. Homme Anim. 709, 1922, non Castellani.

Parendomyces pulmonalis Plaut apud Mautner, Centralbl. Bakt. I, **74**: 207-208, 1914. [Case history in Wiener Med. Woch. **64**: Col. 1055-1067, 1914.]

Candida pulmonalis Almeida, Annaes Fac. Med. São Paulo **9**: 11, 1933.

Myceloblastanon pulmonare Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928 (perhaps *Monilia pulmonalis* of Castellani).

Monilia Mautneri Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 366, 367, 1934.

Isolated from sputum. Not pathogenic to rabbit.

Spores smaller than in *Monilia candida* Bonorden. No mycelium.

Monilia Samboni Castellani, Proc. R. Soc. Med. (Derm.) **6**: 36, 1912.

Saccharomyces Samboni Castellani & Chalmers, Man. Trop. Med. ed. 2, 768, 1913.

Isolated in intertriginous dermatitis of scrotocrural and axillary regions. Skin reddens with possibly slight exudation, borders marked but not elevated. Little pruritus. Treatment: $KMnO_4$ solution, 1:4,000, or resorcin, 1:100, followed by dusting with a powder composed of boric acid and talc.

Cells 6-8μ in diameter. Colonies white, rapidly confluent.

Monilia vaginalis Escomel, Bull. Soc. Path. Exot. **17**: 922, 1924.

Endomyces sp. Carpano, Ann. Ig. Sperim. **22**: 435-450, *Pl. 10,* 1912.

Isolated from pleuropulmonitis in a horse. Disease reproduced in rabbit and guinea pig.

In liquid from lungs, cells very variable in size and shape, reaching a maximum length of 20-25μ, usually 16-20 × 5-7μ, spherical or ovoid cells about 4-6μ, longer cells often cylindric or nearly so, often united into groups of 2 or 3, or more rarely into short simple or branched hyphae up to 200μ long.

Attempts to isolate were unsuccessful on most media tried, due to an actively growing *Streptococcus*, but cultures on potato and potato agar were successful. On potato, colony shining, dirty gray becoming brownish in age. On potato agar, whitish, bright, then graying as the colony thickens. Cells spherical to slightly ovoid, 3-4μ in diameter in 15 days.

Characters intermediate between *Saccharomycopsis guttulatus* and *Zymonema farciminosum.*

Oidium sp. Coley & Tracy, Jour. Med. Res. **16**: 237-249, *Pls. 18-20,* 1907.

Perhaps *Zymonema dermatitidis.* This organism shows much mycelium, somewhat suggesting *Madurella* or *Scopulariopsis.* It is not yeastlike.

Monilia sp., Flu & Woensdregt, Meded. Burgerl. Geneesk. Dienst Nederl. Indië **6**: 1-26, *6 figs.,* 1918.

Isolated from blastomycosis of the central nervous system. Pathogenic to guinea pigs.

In spinal fluid, cells 6-7μ in diameter, spherical, in chains of 3-8. Organism gram-positive. No spores found in culture.

On Sabouraud agar in 3 days, at 26° C., colony opaque, circular, smooth, shining, moist, 1-2 mm. in diameter, china white, hemispheric, becoming yellowish white or yellowish brown. In broth, liquid remains clear with slight sediment and pellicle in about 10 days. Pellicle crumbles and settles after a time. No fermentation of sugars.

Parendomyces sp. Launois et Pinard, Soc. Path. Comp. 1912.

Monilia de Launois et Pinard Sartory, Champ. Paras. Homme Anim. 708, 1922.

[**Monilia sp.**] Williams, Med. Jour. Australia **2**: 185-187, *4 figs.,* 1922.

Isolated from cerebrospinal fluid in case of systemic blastomycosis. Pathogenic for rabbit.

Cells in tissue somewhat elongate, sprouting from ends. In cultures only spherical cells observed.

Colony yellowish white, sticky, coalescing and running down surface of slant. Broth cultures turbid, appearing as if a gel were present.

This organism is possibly *Zymonema capsulatum,* but was transferred too frequently to secure hyphal formation. Not described fully enough to permit of definite placing.

CHAPTER XII

SACCHAROMYCETACEAE

The Saccharomycetaceae, or true yeasts, may be regarded as direct derivatives of the Eremascaceae where growth of the thallus by sprouting has become almost universal. Some species, such as *Saccharomycodes Ludwigii, Debaryomyces Kloeckeri,* and *Zygosaccharomyces Priorianus,* are still able to form true hyphae on gelatin substrates, but the hyphae are unstable and with a slight alteration of the medium break up into sprout mycelia.

The sprout cells are generally spherical or ellipsoid and hyaline, the size varying according to medium and age. Under unfavorable conditions they store fat and glycogen and form a double membrane. These resting cells, which are very resistant to environmental changes and carry the organism over unfavorable periods, are probably chlamydospores. At germination each cell ruptures the outer fragile wall and grows into a sprout mycelium.

On the basis of their method of cell multiplication, the yeasts are often divided into two tribes. In the Schizosaccharomyceteae, each cell elongates, abjoints two equal daughter cells which round off, separate, and again abjoint. At present only a few species are known. In the Saccharomyceteae, sprout cells begin as small lateral protrusions of the mother cell; they are abjointed, increase in size, and finally attain the appearance of the mother cell. This tribe contains most of the true yeasts. The tribes are not absolutely distinct since *Saccharomycodes Ludwigii* usually divides as in the Schizosaccharomyceteae but occasionally multiplies by sprouting, although the sprout cells are produced only at the poles of the mother cell, never laterally. If sprouting or division occurs rapidly, the cells may cling together in small colonies or, in occasional old cultures, in filaments.

Under certain conditions, as in age, with the exhaustion of nutrient, or on solid substrates as gypsum blocks, asci with ascospores are formed. In the wild yeasts the number of ascospores varies from 1 to 12; in many industrial yeasts, certain numbers predominate; e.g., in *Schizosaccharomyces octosporus* 4 or 8, in *Saccharomyces cerevisiae* 4, and in *S. Pastorianus* 2. The spores are spherical to ellipsoid and either smooth or rough. Ordinarily the spore wall has only one layer, but in *Saccharomycopsis guttulatus,* isolated from feces, there are two layers, the outer of which ruptures on germination.

In 3-day cultures of *Schizosaccharomyces octosporus,* the cells copulate in pairs by short tubes (Fig. 57, *1-6*). Where the cells are in short chains, the separating wall between sister cells may dissolve (adelphogamy). Two nuclei migrate into the copulation canal and fuse; the copulation canal broadens and each of the two individuals develops into a barrel-shaped structure, where, within approximately half an hour, after three or more, rarely two, nuclear division, there appear 8—rarely 4—spores (Fig. 57, *7-11*). Often the copulatory canal is narrow so that the young ascus is shaped like a dumbbell between whose ends are divided the 8 spores. At germination, the spores in the ascus swell, rupturing the ascus wall. Each spore thus liberated is divided by a septum into two daughter cells. These cells continue to divide similarly, and in some liquid media they form short branched filaments.

Under unfavorable conditions, copulation may occur earlier, so that already in the ascus the ascospores copulate with ascospores of the same or a neighboring ascus. In these cases the resulting zygote becomes an ascus directly without first forming a sprout mycelium. Other strains have a tendency to become asporogenous; although they may still form copulatory processes, which may be functionless. In very rare instances, there seems to be a parthenogenetic development of spores—4 to an ascus. Copulation is normally isogamous and the gametangial copulation is replaced by pseudogamy. This also disappears and the cells, after unfruitful attempts at copulation, may change parthenogenetically to asci. In *Schizosaccharomyces Pombe,* an African beer yeast, and in *S. mellacei,* from rum factories of Jamaica, many asporogenous strains are known, and in *S. asporus*, from arrack in Java, spores have never been observed.

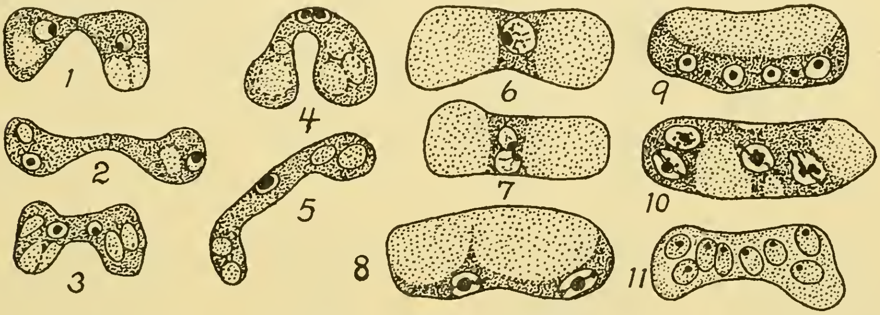

Fig. 57.—*Schizosaccharomyces octosporus.* Copulation and development of asci (×750). (After Guilliermond 1905, 1917.)

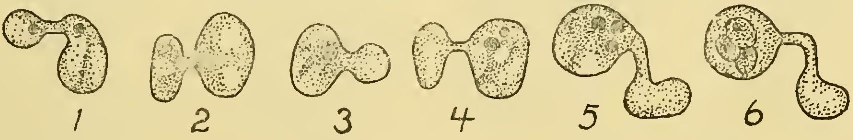

Fig. 58.—*Zygosaccharomyces Chevalieri* showing stages of copulation. (After Guilliermond 1913.)

In the Saccharomyceteae, we have two series of degeneration, one isogamous characterized by a smooth ascospore, the other heterogamous with a rough one. In the simpler forms of the smooth-spored series, as in *Zygosaccharomyces*, 2 cells form copulatory processes toward each other, the nuclei migrate into the bridge and fuse (Fig. 58, *1-3*). This diploid nucleus divides, both daughter nuclei migrate back into the copulating cells, there dividing a second time forming 2 spores in each copulating cell. The whole cell, similar in shape to a dumb-bell, is an ascus (Fig. 58, *4-5*). In some cases, at least in *Zygosaccharomyces Priorianus,* copulation is absent, and the individual sprout cells develop parthenogenetically to asci. Rarely, in small colonies where the mother cell lacks other cells, it may copulate with a daughter cell in pseudogamy.

That which is anomalous in *Zygosaccharomyces Priorianus* becomes increasingly common in other species; as sexual tendencies weaken, copulation becomes more and more difficult. Thus in some species, such as *Z. mongolicus,* although copulation does occur, most of the asci develop parthenogenetically after putting forth copulation tubes which fail to function.

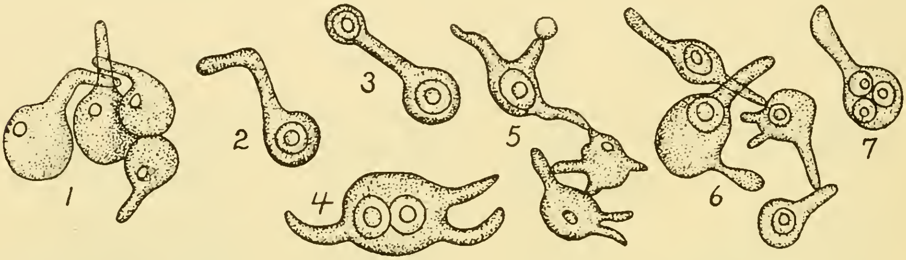

Fig. 59.—*Torulaspora Rosei.* Development of asci (×1,800). (After Guilliermond 1912.)

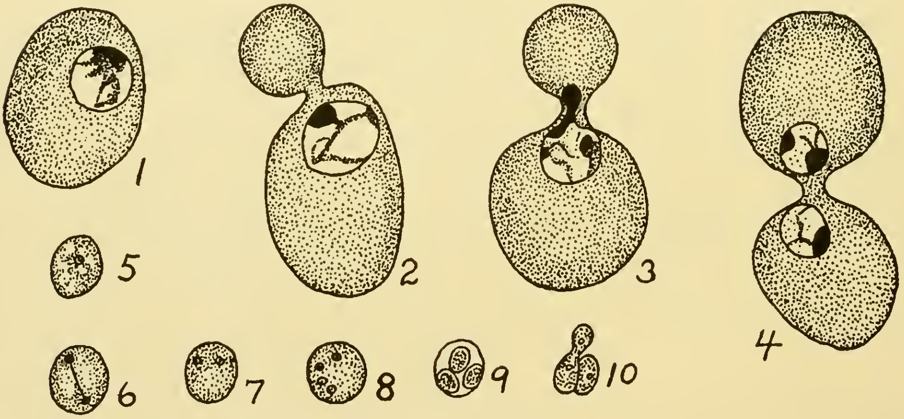

Fig. 60.—*Saccharomyces cerevisiae. 1-4,* formation of sprout cell with amitosis of nucleus (×1500); *5-10,* development of sprout cell to ascus and germination of ascospore (×750). (After Guilliermond 1902, 1904.)

Torulaspora shows still further degeneration toward parthenogenesis. On favorable media, the sprout cells of *T. Delbrucki* form numerous sprout cells which attempt fusion (Fig. 59). Occasionally this is successful and ascospores are formed, but generally the separating wall is not dissolved, and each cell forms 1-4 ascospores parthenogenetically. While copulatory processes are formed in *T. Rosei* and *T. fermentati,* they never fuse, and parthenogenesis is complete.

Finally complete parthenogenesis with no morphologic suggestion of sex is reached in the large genus *Saccharomyces* (Fig. 60). This genus furnishes most of the common yeasts used in alcoholic fermentation, such as *S. cerevisiae,* the beer yeast, S. *ellipsoideus*, the wine yeast, etc. A few species have been reported as pathogenic, but generally they are rather imperfectly described.

The heterogamic series producing rough ascospores is less known and has not degenerated quite so far. In *Nadsonia fulvescens* ascospore formation does not generally occur within the larger fusion cell; on the side opposite the copulatory canal, a sprout cell receives the united contents of both fusion cells and develops 1 or 2 brown ascospores (Fig. 61). Thus we find a trace of ascus formation characteristic of the Eremascaceae, as also cell division intermediate between that of the Schizosaccharomyceteae and normal sprouting. In *N. Richteri* occasionally the male cells are not present on liquid media. In this case long copulation tubes are formed.

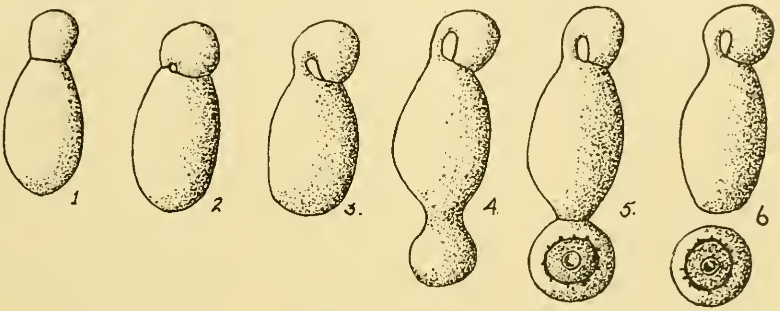

Fig. 61.—*Nadsonia fulvescens.* *1-3*, copulation of mother and daughter cell; *4, 5*, development of ascus; *6*, ascus set free with ascospore. (After Guilliermond 1928.)

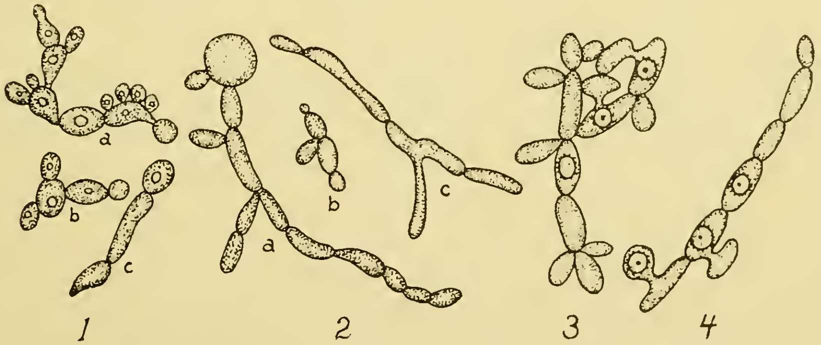

Fig. 62.—*Debaryomyces Kloeckeri*, development of asci. (After Guilliermond & Péju 1920.)

In *Debaryomyces*, traces of a separate ascus formation have disappeared. While copulation is typically heterogamous, we find increasing parthenogenesis. In *D. globosus*, from earth in the Virgin Islands, about 75% of the asci are parthenogenetic. Occasionally copulatory processes are formed, but they grow past each other, apparently for lack of sexual attraction. Copulation occurs in about one-fourth of the cases. This may take place between two mature individuals, where the zygote nucleus either divides in the bridge and returns a daughter nucleus to each fusion cell or migrates before division into one fusion cell and there forms a spore (Fig. 62, *3, 4*). Copulation may also occur between a mother cell which is still sprouting and a young daughter cell, in which case the contents of the daughter cell migrate back into the mother cell and form spores. In other species this becomes the rule as in *D. mucosus* (Sartory, Hufschmitt & Meyer 1930). *Debaryomyces* frequently occurs in cutaneous infections. In *Saccharomyces* (Fig. 60) all trace of sexuality has been lost.

Finally, we should describe a phenomenon whose phylogeny is not clear. It seems to be present in several genera which otherwise do not appear closely related. When *Zygopichia Chevalieri* of the Pichiaceae is insufficiently nourished, 2 ascospores may copulate after they have swollen and ruptured the ascus wall, or an ascospore may copulate with a sprout cell and change to a 1-spored ascus, or the ascospore may function without copulation, as an ascus and form more ascospores. In *Williopsis Saturnus, Saccharomyces ellipsoideus, S. Chevalieri, S. Mangini,* and *S. annulatus,* this phenomenon is common. On germination some spores develop the normal sprout mycelium, while others copulate in pairs. The zygote begins to sprout, forming an apparently diploid sprout mycelium in the copulatory canals, occasionally also on the whole surface of the copulating cells. Later, without further sexual processes, the ascospores develop in the vegetative cells. Finally, we have the curious genus *Saccharomycodes,* whose sole species produces asci with 4 spores which lie in pairs at the two poles (Fig. 63, *1, 2*). The spores at a given pole result from the division of one nucleus, thus they are sister cells and are connected by a protoplasmic layer remaining from the periplasm. At germination they swell much in the ascus and form small copulatory canals (Fig. 63, *1-4*). Occasionally several spores fuse. Two cells of the same sexual tendency attract a third of a different tendency. Copulation may be retarded and the tubes continue to grow, perhaps rupturing the ascus wall. The copulatory processes may fuse with spores from the other pole of the ascus; or some spores may abort, in which case fusion with spores of another ascus is possible (Fig. 63, *9*). Very rarely in old cultures, spores may germinate parthenogenetically and develop special strains which continue to reproduce parthenogenetically through several generations at least. After fusion of the copulatory processes, the nuclei migrate into the bridge and fuse (Fig. 63, *6, 7*). Occasionally fusion may occur in one of the spores instead of in the canal or may be retarded and occur only in the germ tube which grows out of the copulatory canal, ruptures the ascus wall, and germinates to a sprout mycelium. Guilliermond (1931) suggests that these forms in which copulation between ascospores occurs, may be derived from the Taphrinaceae where Juel and others observed copulation between sprout mycelium from germinating ascospores. It is uncertain whether this copulation of ascospores has phylogenetic significance, since we find it among widely divergent groups, such as *Ascoidea, Williopsis,* and *Saccharomyces.* In *Ascoidea,* Walker believes it is purely a vegetative fusion.

Determination of Species.—Two media have been widely used in studies of yeasts: malt extract and yeast decoction. The former is prepared as follows (Guilliermond 1928):

Barley is germinated on moist blotting paper on plates. When the grain has swollen and the radicle has begun to emerge, it is dried in an oven at 30° C., and ground in a mortar. Two hundred grams of powder are stirred into a liter of cold water which is slowly heated to 60°, and this temperature is maintained for 45 minutes, with occasional stirring of the mixture. Four grams of hops are added and the whole boiled for about an hour. The resulting decoction is then sampled, the amount of maltose determined, and the whole diluted to bring the concentration of maltose to 3%. It is then sterilized in the autoclave at 120° C. The decoction is usually used to prepare either 1.5% agar or 6-15% gelatin. The malt extracts now on the market seem suitable and have yielded good results in our laboratory. The preparation of media from them is much less tedious.

Yeast decoction is prepared by boiling and stirring 100 gm. fresh yeast in 1 liter of distilled water, filtering, and autoclaving. The liquid furnishes a small amount of available nutrient so that some sugar is often added.

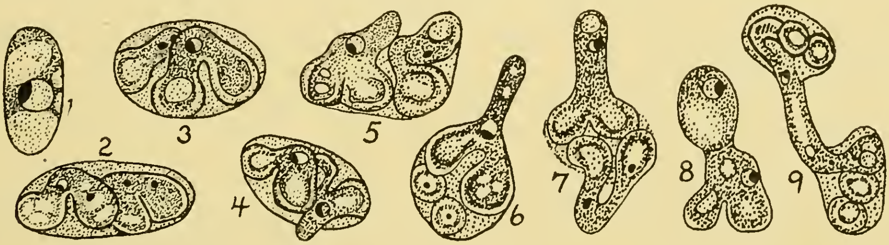

Fig. 63.—*Saccharomycodes Ludwigii.* Copulation and development of asci (×750). (After Guilliermond 1905.)

The macroscopic characters on malt extract incubated for 24 hours at 25° C. are studied. Some yeasts form a white sediment in the bottom of the test tube, while others grow mostly at the surface, forming a pellicle or, if they creep up the sides of the tube, a ring. If the tube is not handled carefully, the pellicle may break up and settle as a sediment, but if left alone a new pellicle will soon form. Often the pellicle is characteristically folded, etc. Fermentation should also be observed if present.

The microscopic characters are more variable. One should observe the general shape and size of the cells, the method of budding, whether only terminal or lateral, whether a pigment is characteristically produced. For variation in appearance of cells of different ages, the following account is summarized from Shrewsbury (1930):

The adolescent cell (Fig. 40, *1-3*) is spherical to allantoid in shape with a thin cell wall and refractile, homogeneous cytoplasm. Sprouting is usually most active at the poles, but may occur anywhere. The mote cell is larger than the adolescent cell, and the cytoplasm more granular. A single vacuole, rarely more, fills about half the cell, and highly refractile corpuscles or motes (probably metachromatic granules) showing Brownian movement are seen in the vacuole. After these appear in culture, growth slows down, and reserves of fat and glycogen are stored in preparation for formation of ascospores or of resistant cells.

The adult or durable cell (Fig. 40, *4* and *5*) often persists unchanged in cultures for months. This cell is larger with a vacuole, empty or containing a single oil globule, occupying three-quarters of the volume. Fat is usually stored in a large polar globule, occasionally as small globules around the vacuole. The globules consist of an outer layer of albuminous substance enclosing a semifluid emulsion of fatty substances. Shadow or senescent cells are empty cell walls from which the contents have disappeared by rupture or otherwise (Fig. 40, *6-9*).

The permanent cell is often still larger with a dark-colored wall thinner than that of the normal cell. Vacuoles are usually absent, though occasionally present, dark granules are present and, usually, fat globules also.

Sometimes there results a pseudomycelium (Fig. 40, *10*) composed of adolescent cells, nonvacuolated cells with fat globules, and cells having finely granular cytoplasm—the latter cells never seen save in pseudomycelium. Occasional bizarre forms occur whose shapes are usually the result of multiple abnormal budding.

In the rare red yeasts even conidia are produced, especially in the genus *Sporobolomyces*, whose method of conidial discharge sometimes causes it to be placed in the Basidiomycetes, a very distantly related group of fungi.

Physiologic characteristics should be noted, such as temperature limits of sprouting, optimum temperature for growth as determined by colony size, the temperature limits of formation of pellicles, etc. Sporulation should be induced if possible. The media most commonly in use are gypsum blocks and Gorodkova's agar. The yeast is cultivated for 24 hours on malt extract agar; the growth is then scraped off and placed on a short cylinder of plaster of Paris by means of a platinum spatula. The cylinder is placed in a sterile Petri dish, filled to about half the height of the cylinder with sterile water. Spores often appear in 1-8 days.

Gorodkova's* agar may also be used. It consists of: distilled water 1,000 c.c., agar 10 gm., peptone 10 gm., beef extract 10 gm., sodium chloride 5 gm., glucose 2.5 gm.

This enables the yeast to start growth, but the nutrients are quickly exhausted and sporulation often results in 1-8 days. Some species which do not form spores on either of these media will produce them on carrot in very old cultures. Maneval (1924) reports spore formation in cultures kept in the ice box.

Once the asci have been obtained, their form, method of formation, and the shape and size of their spores should be observed. It is often very difficult to distinguish spores from the large oil globules found in many yeasts. Spores are usually much more uniform in size and do not stain readily with Sudan III or osmic acid.

---

*Maneval (1924) omits the peptone and reduces the Liebig meat extract to 3 gm. in this formula. He also recommends 15-20 gm. of agar.

The method of Moeller (Hufschmitt, Sartory & Meyer 1931) is also suggested: Treat for 10 seconds to 5 minutes in 1% sulphuric acid, wash, stain with carbolfuchsin, heating for 1 minute, differentiate with 5% sulphuric acid for 5 seconds; wash, counterstain with aqueous methylene blue for 3 minutes. Also the method of Schumacher (Buschke & Harry 1923): Fix, stain for 1 minute in carbol-methylene blue, rinse with distilled water, stain 1½ minutes with slow movement or slide with 1% phosphin (diamidophenylacridin). Spores also stain with Ziehl-Neelsen acid-fast procedure if the sulphuric acid is replaced by 1% nitric acid in alcohol. Fatty acids may be stained blue and neutral fats red by the technic of Smith (1907). For further methods see Shrewsbury (1930).

The germination of the ascospores should be noted, if possible, especially whether there is copulation between them.

Many species form very characteristic giant colonies, while others do not. Some also produce rather characteristic liquefactions of gelatin.

Among the pathogenic yeasts, Fontoynont reports very good results in dressing the lesions with methylene blue; he also recommends 0.1 gm. methylene blue *per diem* administered *per os*, stating that it is tolerated for several months at a time.

Key to Genera

Cells dividing by septa, sprouting absent or rare, asci usually 4-8-spored. *Schizosaccharomyces.*

Cells dividing by sprouting, septa absent.

- Spores rough-walled, copulation usually heterogamic.
  - Ascus sprouting from the zygote, cell division sometimes suggesting that of *Schizosaccharomyces*. *Nadsonia.*
  - Ascus developing directly in the zygote. *Debaryomyces.*
- Spores smooth, copulation usually isogamic or absent.
  - Ascospores thick-walled with a double membrane. *Saccharomycopsis.*
  - Ascospores thin-walled without a double membrane.
    - Copulation between vegetative cells prior to ascospore formation, parthenogenesis rare. *Zygosaccharomyces.*
    - Copulation produced but usually not functional, ascospores commonly resulting from parthenogenesis. *Torulaspora.*
    - Copulation absent. *Saccharomyces.*
    - Copulation between ascospores while still in the ascus. *Saccharomycodes.*

SCHIZOSACCHAROMYCES

Schizosaccharomyces Lindner, Woch. Brauerei **10**: 1298, 1893.

The type species is *Schizosaccharomyces Pombe* Lindner.

Cells cylindric or elongate ellipsoid; vegetative division by fission not by sprouting; asci arise after isogamous copulation; spores spherical or ovoid with smooth wall which is colored blue by $KI.I_2$; 4-8 spores per ascus. Sediment in malt extract, occasionally also a ring is formed. Various sugars strongly fermented; nitrate not assimilated, no growth with ethyl alcohol as a substrate.

So far there has been no case of pathogenicity for mammals which has not been shown to be wrongly referred here. Apparently *Bacillus megatherium* has been frequently picked up as a contamination and referred here, the granule or oil globule being mistaken for a small spore. All reports of this genus with spore number fewer than four, especially if the cell size is small, should be studied very critically before admission to this group.

Schizosaccharomyces hominis Benedek, Centralbl. Bakt. I, **104**: 291-303, *2 pls.,* 1927. See also other papers by Benedek.

Dorrepaal (1930) shows conclusively that this organism is a bacillus either identical with or closely related to *Bacillus megatherium* Bary.

DEBARYOMYCES

Debaryomyces Kloecker, C. R. Trav. Lab. Carlsberg **7**: 273, 1909.

The type species is *Debaryomyces globosus* Kloecker.

Cells predominantly spherical but also ovoid, mostly small; vegetative reproduction by sprouting. Asci following isogamous or heterogamous copulation occasionally parthenogenetic; spores spherical mostly with a large central oil globule, wall verrucose (warts often difficult to see), usually only 1 spore per ascus. In malt extract, producing sediment, usually a ring and occasionally a pellicle. In most species no fermentation, very few species having a good fermentation; nitrate assimilation negative; with ethyl alcohol as a substrate, growth good, often producing a thin pellicle on this medium.

Key to Species

Glucose and sucrose strongly fermented, slight ring but no pellicle.	
Colonies becoming bister or darker on agar.	*D. Hudeloi.*
Colonies remaining white or light colored.	*D. mucosus.*
Colony color unknown.	
Asci, 2-5μ in diameter.	*D. emphysematosus.*
Asci, 5-7μ in diameter, fermentation questioned.	*D. Gruetzii.*
No fermentation or a weak fermentation of glucose only. [Ota reports slight fermentation of some other sugars, probably either due to impurities or to the methods used.]	
Ring formed on malt extract but no pellicle.	
Sucrose not inverted, cells 2-3.5 × 3-7μ, ovoid, occurring in chains in old cultures.	*D. Kloeckeri.*
Sucrose slightly inverted, cells 2-8 × 2-6μ in groups springing from the same mother cell.	*D. Nadsoni.*
Sucrose inverted.	
Cells 3.6-5.4 × 1.8-3μ, cells single or in pairs.	*D. Matruchoti.*
Cells 2-6μ rarely 8-10μ, rarely also in chains.	*D. Fabryi.*

No ring or pellicle on malt extract, sediment brownish white, sucrose inverted.	
	D. Leopoldi.
	D. Lundsgaardi.
	D. Laedegaardi.
	D. Hildegaardi.
Pellicle on malt extract, sucrose inverted.	*D. Guilliermondi.*
Fermentation unknown, probably close to *D. Fabryi.*	*D. Burnieri.*

In the following descriptions I have tried to translate and bring together the salient points of each organism under the original name. Ota's descriptions of numerous new species seem to have been too hurriedly written without a sufficient background to appreciate the stability of characters and with too little biometric data to give much validity to his cell measurements. Since most of the cultures had been isolated many years previous to his studies and been carried in stock cultures for so long, it is possible that they may not be the original organism isolated from the cases mentioned. Quite probably Dekker is right in referring most of his species to *D. Matruchoti.* On the other hand, it seems strange that a single species of yeast should produce such different types of lesions as Ota's various species have been reported to do.

Debaryomyces Hudeloi (Gougerot) Fonseca, Brasil Med. **36**: 101-102, 1922.

Cryptococcus sp. Hudelo, Duval & Laederich, Bull. Mém. Soc. Méd. Hôp. Paris **23**: 723-734, 1906.

Atelosaccharomyces sp. Duval & Laederich, Arch. de Parasitol. **14**: 224-318, 1911.

Atelosaccharomyces Hudeli Gougerot, Paris Méd. **1**: 462, 1911.

Debaryomyces Kloeckeri var. *Hudeloi* Dekker, Verhandel. K. Akad. Wetensch. Amsterdam Afd. Natuurk. **28**: 473, 1931.

Isolated from blastomycosis with multiple foci, clinically more or less similar to that produced by *Atelosaccharomyces hominis.*

Pathogenic for mice, less so for rats and guinea pigs, not for rabbits, dogs, or hens; subcutaneous inoculation in guinea pig produced abcesses, which healed spontaneously in a fortnight.

Cells usually spherical, occasionally ellipsoid, isolated or in pairs, very rarely in short chains of 4-5 cells, mostly 2-4μ in diameter, with ellipsoid cells up to 8μ and giant cells $16 \times 6\mu$ [original description states cells 2-20μ] mostly uniguttulate (Fig. 64, *1-3*). Copulation heterogamous, asci 1-spored, ascospores 2-3μ in diameter, sparingly echinulate with a large fat globule (Fig. 64, *4*).

Optimum temperature 22° C., growth very good at 38° C., not anaerobic. Ota reports that after 18 years optimum temperature is 30°, growth poor at 37°, good at 12° C.

On Sabouraud glucose agar, colonies opaque, smooth, moist, shining, margin regular becoming undulate, consistency mucous, viscid, strongly adherent to the agar but not penetrating it, 1.5 mm. thick, creamy, growth not spreading, finally becoming yellow bister, then café-au-lait, and deep brown after 8-10 months. Similar, but less luxuriant on lactose, maltose, and sucrose agar; remaining pale yellow, small, punctiform on glycerol and peptone agar. On malt agar, Ota reports cells larger, chains sometimes branched, cells up to 8μ in diameter. On potato and potato with glycerol, growth good, creamy, white, smooth, shining, moist, 2-3 mm. thick, mammillate, the upper portion dry and efflorescent, below in contact with the glycerol, colony moist, diffluent with viscid or translucent streaks forming abundant mucous deposit. Finally, the colony is ochre yellow to sepia, with new pale yellow colonies dotting the surface of the old colony. After 6-8 months, the colony forms a thin dry pellicle, almost scaly, gray or reddish above and almost black below. On carrot, a thin diffluent streak which never forms a thick colony. Ota reports occasional chains, with branches several cells long. On gelatin, growth slow, colonies grayish white, mucous. No growth on coagulated serum. On broth, growth slow, with whitish flocculent or pulverulent deposit, no turbidity. On sugar broths, limpid, ring formed but no pellicle, deposit a white clot which disintegrates on shaking, producing turbidity which soon settles out. Ota reports no ring in 30 days on malt extract, sediment brownish white. Gelatin not liquefied; sucrose inverted, glucose, maltose, and sucrose fermented, lactose not fermented.

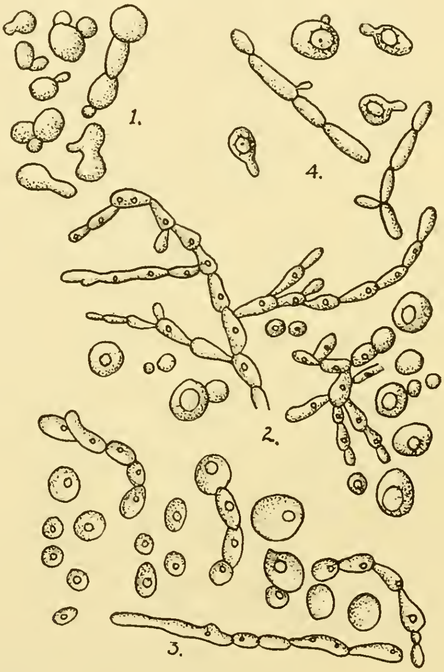

Fig. 64.—*Debaryomyces Hudeloi.* *1-3,* sprout mycelium; *4,* asci with ascospores. (After Ota 1923.)

Debaryomyces mucosus A. & R. Sartory, Hufschmitt & Meyer, C. R. Acad. Sci. **191**: 281-283, 1930. Case history and pathology in Hufschmitt, Sartory & Meyer, Ann. Derm. Syphiligr. VII, **2**: 850-876, *11 figs.,* 1931.

Isolated from abscess on neck, not painful, in some cases healing spontaneously. No organism seen in the tissue, discharge showed a yeast and a streptococcus. On guinea pig caused abscess which healed spontaneously.

Growth slow on solid media. In liquid media showing some budding cells, cells 3-4μ, filled with dense protoplasm and asci 4-5 (-12)μ in diameter with 4 spores, and at the bottom a zoögloea of round cells. Cells more elongate on repeated subculture. With beginning of ascospore formation in the culture, sprouting largely ceases. Copulation heterogamic, often between a sprout and an adult cell. Parthenogenesis occasional. Ascospores spherical, slightly rough, with one to several oil drops, 2-3μ in diameter.

Colonies on sugar agar somewhat hilly, shining, viscid, with a brownish mucous deposit in water of condensation. Ascospores appear after the twelfth day, their number finally, after repeated transfer, being reduced to one. On usual media, colonies dirty white. Giant colony on potato agar attains a diameter of 5 cm. with elevated mounds at the center and a few radiating striae, margin crenulate. On potato juice, colony is humid and shining, later becoming ochraceous. Growth best on potato media, giving colonies of a cream color which later darkens to chamois yellow. Optimum temperature 37° C., growth slow at room temperature. In liquid media, there is a brownish yellow sediment, no pellicle, but a slight ring. Sucrose inverted, sucrose, and glucose fermented, no action on other sugars. No effect on gelatin or coagulated serum.

Debaryomyces emphysematosus Ota, Derm. Woch. **78**: 284-289, 312-316, 1924.

Hefe emphysematosus Sasakawa, Centralbl. Bakt. I, **88**: 273, 1922.

Organism received from Hautklinik, Bern, marked *Sacc. emphysematosus.* It is nonpathogenic for laboratory animals.

On malt extract agar after 24 hours appear cells, usually solitary, very rarely in chains, 2-5μ in diameter, no fat globules. After 3 days on carrot, asci appear. Both heterogamous and isogamous asci smaller than in other species. Spores very slightly verrucose.

Glucose, fructose, sucrose, and raffinose fermented.

Debaryomyces Kloeckeri Guilliermond & Péju, C. R. Soc. Biol. **82**: 1343, 1919; Bull. Soc. Myc. France **36**: 164-172, *10 pls.*, 1920; Konokotina & Krassilnikov, Jour. Microbiol. Leningrad **9**: 93, 1929; Bachinsky, Jour. Microbiol, Leningrad **9**: 14, 1929.

Originally isolated from the throat of a patient with angina. Later isolated from fluid obtained in lumbar puncture by Bachinsky, 1929, in Leningrad.

Cells ovoid, 2-3.5 × 3-7μ in young malt extract cultures, with sediment and ring. Asci 1-spored, heterogamous, rarely isogamous, copulation. Spores spherical, verrucose, with oil droplet.

Colony on malt agar, after 75 days at 15° C., gray yellow (Klinsieck Code 103A), moist, shining, center elevated and granular, with radial folds and wavy margin. Growth on ethyl alcohol good, but organism cannot assimilate nitrates. Slight fermentation of glucose.

Debaryomyces Nadsoni Guilliermond & Péju, Bull. Soc. Myc. France **37**: 35-38, 1921; Rev. Méd. de l'Est [Nancy] **50**: 342-347, 1922.

Isolated from a case of sycosis, probably a secondary invader.

Cells spherical or ovoid, often united in groups consisting of a mother cell and the cells sprouted from it, the older cells containing a single oil globule, 2-8 × 2-6μ. Asci arising from heterogamic copulation between a large and small cell, often between mother and daughter. Usually one (rarely more) ascospore per ascus, 2-3μ in diameter, wall rough, containing one oil globule. At germination, the ascospores swell and lose the verrucosities of the wall. Minimum temperature for sporulation 8°-9° C., optimum 20°-25° C., maximum 34°-35° C.

Growth between 3° and 46° C., optimum 25°-30° C. On malt extract, whitish deposit visible after 36 hours; a ring formed after 5 or 6 days but no pellicle. By Lindner's microfermentation method, no fermentation was observed, sucrose slightly inverted.

Debaryomyces Matruchoti Grigorakis & Péju, C. R. Soc. Biol. **85**: 459-462, 1921.

Isolated from feces of patient suffering from helminthiasis.

After 24 hours at 25° C., on malt extract, cells spherical or ovoid, 3.6-5.4 × 1.8-3μ. In old cultures, cells usually ovoid with large fat globule. On Gorodkova agar, sporulation is common, usually heterogamous but occasionally isogamous. Asci are 1-spored. Spores verrucose with large oil globule.

On malt agar, after one month at 25° C., colony attains size of a one-franc piece, white and shining, center slightly rosaceous. On Gorodkova agar, old colonies are chocolate brown. In malt extract liquid, a slight sediment appears after 48 hours at 25° C., finally a ring, but no pellicle. On malt gelatin, colony slight yellowish white, center raised, margin lobed, rays present. The gelatin is not liquefied. Upper limit of growth is 37°-38° C., sporulation limit 30°-32°. Sucrose inverted, mannose alone fermented. Dekker (1931) claims there is no fermentation at all.

Debaryomyces Fabrii Ota, Derm. Woch. **78**: 286-289, 312-316, 1924.

Hefe Fabry, München. Med. Woch. **64**: 1557, 1558, 1917.

Debaryomyces Fabryi Dekker, Verhandel. K. Akad. Wetensch. Amsterdam, Afd. Natuurk. **28**: 475, 1931.

Isolated from interdigital mycosis in Dortmund. Nonpathogenic to mouse.

On malt agar, after 24 hours at 25° C., cells spherical or ovoid, 2-6μ in diameter, occasionally 8-10μ, in groups or pairs, very rarely in chains. At this time the oil drop is very small, but after 10 days the cell is larger and the oil drop large. On carrot, morphology is the same as on malt agar, but the oil drop is larger, and there is more ascus formation. On Gorodkova agar, no mycelium, heterogamy and sometimes isogamy, ascus ovoid or polyhedral with thick membrane 5-6μ. Spores ovoid or polyhedral, verrucose. Oil drop colors readily with Sudan III.

On malt extract a slight ring appears. Growth is good at 38° C., but there is none at 44° C. Fermentation of glucose, denied by Dekker (1931).

Var. **tremoniensis** (Ota) Dodge, n. comb.

Debaryomyces tremoniensis Ota, Derm. Woch. **78**: 284-289, 312-316, 1924.

Isolated from a case of interdigital mycosis in Dortmund, Germany.

Morphology same as that of *D. Fabrii.* Ferments glucose and mannose.

Debaryomyces Leopoldi Ota, Ann. Parasitol. Hum. Comp. **1**: 128-130, 1923.

Saccharomyces neoformans Leopold, Arch. Gynaekol. **61**: 77-120, *Pls. 1-6,* 1900, non al.

Blastomyces (*Leopold*) Sasakawa, Centralbl. Bakt. I, **88**: 273, 1922.

Isolated from carcinoma of the ovary. Originally reported pathogenic to laboratory animals, but is nonpathogenic to guinea pig.

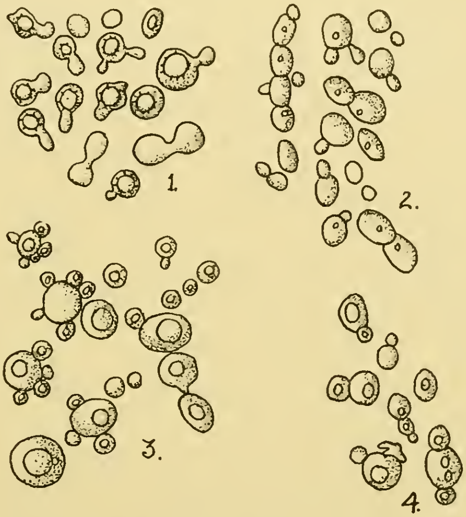

Fig. 65.—*Debaryomyces Leopoldi.* (After Ota 1923.)

After 24 hours on malt agar, at 25° C., cells are ovoid or spherical, the smaller having a diameter of 3-5μ, the larger 6 × 7μ. Cells solitary or in pairs with a tendency to occur in masses, uniguttulate, chains not observed (Fig. 65). After 9 days cells 6-8μ. In 40 days, membrane thickens, oil globules larger and more numerous. Growth on carrot similar. After 9 days on Gorodkova agar, spores appear, asci scarce, but more abundant than in *D. Hudeloi,* 1-spored. Spores 2-3μ, usually echinulate, sometimes smooth. On plaster, asci appear in 4 days. Copulation usually heterogamous, but isogamy has been observed.

Giant colonies, after 30 days, show white rays from center with definite margins. In malt extract, brownish white sediment appears in 30 days. No growth at 40° C., feeble growth at 36° C., growth still good at 12° C., and there is still some at 5° C. No liquefaction of malt gelatin in 35 days. Sucrose inverted, slight fermentation of glucose and sucrose. Trace of fermentation of fructose, galactose, mannose reported. None with maltose, lactose, and raffinose.

Debaryomyces Lundsgaardi Ota, Ann. Parasitol. Hum. Comp. **1**: 130-132, 1923. [Original case by Lundsgaard, Klin. Monatsh. Augenheilk. **38**: 13-19, 1900.]

Hefe Lundsgaard Sasakawa, Centralbl. Bakt. I, **88**: 274, 1922.

Isolated from hypopyokeratitis in 1900. Found nonpathogenic to guinea pig in 1923.

After 24 hours at 25° C., cells spherical or ovoid, 2.5-3.5μ, solitary or in pairs, rarely in colonies, occasionally showing oil globules. In 3 days, some cells are as large as 6-8μ with more abundant oil globules. In 9 days, an occasional chain may be seen, but never such as in *D. Hudeloi*. After 40 days, occasional cells as large as 12 × 15μ. On carrot, form and size of cells as on malt agar, but with more giant cells, thicker membranes, and larger fat globules. Sporulation is rare but heterogamous, the male cells being small and elongate. Asci spherical or ovoid, 3-5μ in diameter, with thick wall. Ascospores 2-3μ, slightly echinulate, containing small oil globule.

Giant colony attains diameter of 5 cm. in 35 days, is brilliant white with fine radial rays, margin definite with rare indentations. In malt extract, a brownish white sediment appears. Growth at 35° C., but not at 36° C., good growth at 12° C., and some as low as 5° C. No liquefaction of malt gelatin in 37 days. Organism inverts sucrose, but does not ferment any of the usual sugars.

Debaryomyces Laedegaardi Ota, Ann. Parasitol. Hum. Comp. **1**: 132-134, 1923.

Isolated from skin infection (Sasakawa). Also in Kral collection, without record of pathogenicity. Nonpathogenic to guinea pig.

On malt agar, after 24 hours at 25° C., cells appear ovoid, spherical or, occasionally, cylindric, solitary or in groups, 2.5-5μ in diameter. After 3 days, cells a little larger. After 9 days, a few chains of long slender cells appear. Asci very rare. On carrot as on malt agar, with cells in old cultures up to 10μ in diameter. On Gorodkova agar, in 12 days appear asci, ovoid or polyhedral with thick membrane, 3.5-4μ, or, if oblong, 5-6μ broad. Ascospores 2-2.5μ, verrucose, with small oil globule. Copulation heterogamous.

Giant colony attains diameter of 3 cm. in 25 days, yellowish white with fine rays from center to periphery, edge definite. In malt extract, there is a brownish white deposit without pellicle or ring. No liquefaction of gelatin in one month. Sucrose inverted, glucose somewhat fermented, hence sucrose also. No fermentation with other sugars.

Debaryomyces Hildegaardi Ota, Ann. Parasitol. Hum. Comp. **1**: 134-136, 1923.

Blastomyces Hildegaard Sasakawa, Centralbl. Bakt. I, **88**: 273, 1922.

Debaryomyces Matruchoti race *Hildegaardi* Dekker, Verhandel. K. Akad. Wetensch. Amsterdam Afd. Natuurk. **28**: 471, 1931.

Organism came from Kral collection. Nothing is known of its origin. It is nonpathogenic to guinea pig.

Grown on malt agar at 25° C., for 24 hours, it produces spherical, ovoid, and sometimes elongate cells, solitary or in chains, most often in pairs. In 8 days, cells may be as large as 7μ in diameter. In 40 days, membrane is thickened and large oil globules appear. On carrot, cells are large, up to 10μ in diameter. Heterogamy usual, occasionally isogamy. On Gorodkova agar, after 9 days, appear 1-spored asci. Spores are 2.5-3.5μ, uniguttulate, echinulate.

In malt extract, a brownish white sediment appears. Organism grows at 36° C., but not at 37° C. Growth is fair at 12° C., but at 5° is almost absent. Malt gelatin is not liquefied in 35 days. Reported to invert sucrose, and slightly ferment glucose, fructose, maltose, and sucrose, but not galactose, lactose, mannose, or raffinose. Dekker (1931) denies any fermentation.

Debaryomyces Gruetzii Ota, Derm. Woch. **78**: 283-289, 312-316, 1924.

Debaryomyces Matruchoti race *Gruetzii* Dekker, Verhandel. K. Akad. Wetensch. Amsterdam Afd. Natuurk. **28**: 477, 1931.

Isolated from mycosis of a nail of a six-year-old child in Kiel. Fatal to mouse in 26 days. Organism recovered.

In 24-hour-old cultures on malt agar, cells are spherical or ovoid, solitary or in pairs, sometimes in groups, 2-4μ in diameter. On fourth day these have increased to 7-11μ. Month-old cultures contain many polyhedral cells. Asci appear in 10 days and are ovoid or polyhedral, 5-7μ. Asci appear earlier on carrot. Ascospores are spherical, verrucose, 2-3μ.

On malt extract, yellow brown sediment appears, but no ring. The organism was reported to ferment glucose, fructose, mannose, sucrose, but Dekker (1931), using quantitative methods, denied this.

Debaryomyces Guilliermondii Dekker, Verhandel. K. Akad. Wetensch. Amsterdam Afd. Natuurk. II, **28**: 1: 457-459, 1931.

Cryptococcus Farinae Pollacci & Turconi, nom. nud.

Originally isolated from spoiled sausages by Césari & Guilliermond. Reported by Agostini (1934) from blastomycosis of the Gilchrist type (case of Farina, 1929).

Cells 3-8μ in diameter; asci 4-8μ, 1-spored, copulation isogamous or heterogamous; spores 2.5-4.5μ in diameter, spherical, rough, with a large oil drop.

On Pollacci agar, colonies white, round, margin subsinuous, plane, becoming confluent, creamy white, minutely verrucose. On Sabouraud and malt agar, growth similar but slower, brownish yellow on maltose agar. On carrot and potato, colonies similar but white and powdery. On malt gelatin, colony almost smooth. In liquid media with sugars, pellicle white, thick, elastic, sediment yellowish white. On ethyl alcohol, pellicle thin, dull. No fermentation of sugars, sucrose inverted. Gelatin liquefied.

Debaryomyces Burnieri Ota, Ann. Parasitol. Hum. Comp. **2**: 35-37, 1924.

This organism was isolated from epidermomycosis of eczematous aspect.

Grown on malt agar, at 25° C. for one day, it shows spherical or ovoid cells, 4-5μ in diameter or 8-10 × 5μ, occasionally up to 15μ long, solitary or in twos, occasionally in chains. There are large vacuoles and fat globules. The cell wall is very thin. After 7 days, cells solitary or in twos, membrane thicker. On carrot, cells may be solitary or in groups, but not in chains, walls thick, 1-12μ in diameter. On malt extract, cells often in chains. Gorodkova agar shows sporulation on the third day. Asci spherical, ovoid, or polyhedral, 4-7μ. Ascospores spherical or ellipsoid, 2-4μ, verrucose, uniguttulate.

On malt agar, colony chalky white, smooth, even edges. In malt extract a whitish deposit appears in 24 hours, and on the tenth day a ring which thickens and yellows on the fortieth day. Fermentation not reported.

SACCHAROMYCOPSIS

Saccharomycopsis Schiönning, C. R. Trav. Lab. Carlsberg **6**: 103, 1903.

The type species is *Cryptococcus guttulatus* Robin.

Cells ellipsoid or elongate, sprouting only from the poles; on glucose broth, a thick powdery pellicle; asci parthenogenetic, 1-4-spored, ascospores smooth and thick-walled, exospore rupturing on germination; only glucose fermented, sucrose inverted; gelatin not liquefied, milk clotted.

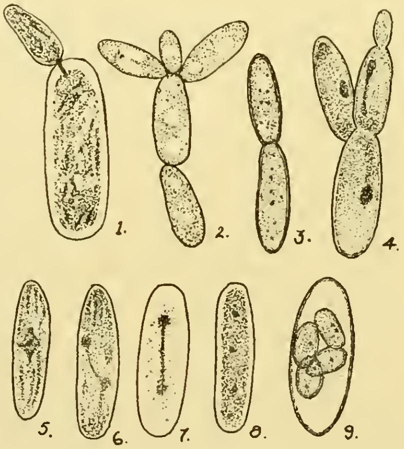

Fig. 66.—*Saccharomycopsis guttulatus.* *1-4,* stages in the formation of sprout cells; *5-9,* nuclear phenomena in the formation of ascus. (After Buscalioni 1896.)

Saccharomycopsis guttulatus (Robin) Schiönning, C. R. Trav. Lab. Carlsberg **6**: 124, 1903.

Cryptococcus guttulatus Robin, Veg. qui Croiss. sur les Animaux Vivants, 52, 1847.

Saccharomyces guttulatus Winter in Rabenhorst, Kryptog. Fl. Deutschl. ed. 2, I, **1**: 72, 1881; Buscalioni, Malpighia **10**: 281-327, *Pl. 7,* 1896; *Ibid.* **12**:

59, 1898; Ann. Ig. Sperim. **8**: 229-243, *Pls. 2-3,* 1898; Wilhemi, Diss. Bern [Centralbl. Bakt. II, **4**: 305-309, 353-361, 412-417, 713, 1898].

Atelosaccharomyces guttulatus Beurmann & Gougerot, Bull. Mém. Soc. Méd. Hôp. Paris III, **28**: 251, 1909.

Remak, Diagnostische und Pathogenische Untersuchungen, 221-225, 1845.

Frequently isolated from feces, especially those of guinea pig (Remak 1845), also from digestive tracts of rabbits. Pathogenic to both guinea pig and rabbit in subcutaneous or intraperitoneal injections.

Cells ellipsoid or oblong-ovoid, 6-8 × 15-20μ (Fig. 66, *1-4*). Asci 1-4-spored (Fig. 66, *5-9*). Exospore ruptured on germination of spore. Spores have not yet been produced on artificial media but are obtained by alternate wetting and drying of the feces.

On glucose agar, colony is thin, moist, dirty white, regular margin with branching in old cultures. On glycerol agar, colony small, center elevated, margin branched and areolate. On potato, colony is slightly elevated, dirty white with elevated white points, margin also elevated, sinuous, slightly powdery. In acid glucose broth, a thick, powdery white pellicle forms. Sucrose inverted, glucose and sucrose fermented. On gelatin, colony circular, moist, whitish, margin irregular. Gelatin not liquefied. Casein precipitated in milk without acid formation.

SACCHAROMYCES

Saccharomyces Meyen, Arch. Naturgeschichte [Wiegemann] **4**: 2: 100, 1837; emend. Reess, Unters, ü.d. Alkoholgärungspilze 80, 1870.

The type species is *Saccharomyces cerevisiae* Meyen.

Cells spherical, ovoid, or elongate, often in small chains, vegetative reproduction by sprouting; in malt extract a sediment, often a ring and very rarely a pellicle; asci parthenogenetic, spores 1-4 per ascus, spherical, ovoid, rarely kidney-shaped, smooth-walled; occasionally spores copulate before germination; glucose always fermented, usually also the other sugars; nitrate not assimilated; poor growth or occasionally good growth on ethyl alcohol as a substrate but never producing a pellicle on this medium.

Key to Species

- Colony rose to vermilion. *S. granulatus.*
- Colony grayish rose, grayish white on peptone gelatin. *S. anginae.*
- Colony yellowish, ochraceous, or brown.
  - Growth only on potato, colonies ochraceous yellow with chocolate center. *S. Ferrani.*
  - Growth on many media.
    - Fermentation with most sugars, colony brownish gray. *S. Hagiwarae.*
    - Lactose not fermented, colonies white at first becoming chocolate brown in one month.
      - Gelatin liquefied. *S. Lemmonieri.*
      - Gelatin not liquefied. *S. Zimmeri.*
    - Lactose and maltose not fermented, colony brownish. *S. tumefaciens.*
    - No fermentation, colony yellowish becoming brown, cells often thick-walled, held together by mucous sheath. *S. Blanchardi.*

- Colony white or whitish.
    - Gelatin liquefied. *S. Lemmonieri.*
    - Gelatin not liquefied.
        - Pellicle formed, sucrose inverted.
            - Maltose fermented.
                - Milk not coagulated. *S. Sternoni.*
                - Milk coagulated. *S. Zimmeri.*
            - Maltose not fermented. *S. labialis.*
        - Pellicle evanescent, maltose fermented, milk coagulated. *S. Jadini.*
        - Only a ring formed, sucrose not inverted, maltose fermented. *S. annulatus.*
        - Neither ring nor pellicle formed. *S. pseudotubercolaris.*

Saccharomyces granulatus Vuillemin & Legrain, Arch. de Parasitol. **3**: 237-268, 1900 [condensed by Pellier, Ann. Derm. Syphiligr. V, **1**: 191-196, 1910].

Case of Fontoynont & Salvat, 1922, referred here belongs in *Cryptococcus Fontoynonti* Vuillemin.

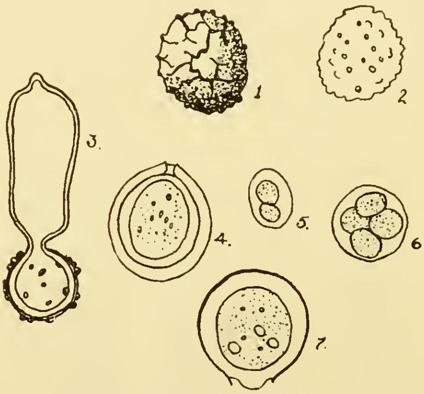

Fig. 67.—*Saccharomyces granulatus.* *1, 2,* sprout cells showing sculptured membrane; *3,* elongate sprout cell; *4, 7,* thick-walled cells; *5, 6,* asci. (After Vuillemin & Legrain 1901.)

Isolated from an abscess (?) of pigeon's egg size on the jaw of a patient with malaria. When lanced, the abscess exuded yeast cells and leucocytes. Organism cultivated. Pathogenic for rabbit.

Cells ovoid or short ellipsoid, 4-5 × 3.3-4μ, solitary, budding. Atypical forms elongate (Fig. 67, *3*), solitary or in simple branched chains with a rose pigment, which is insoluble in alcohol, acid, or alkali, collecting in the oil globules of the old cells. Membrane sculptured with granules occasionally arranged in lines or reticula (Fig. 67, *1, 2*). Vegetative cells sometimes encyst, forming chlamydospores (Fig. 67, *4, 7*). Asci 2-4-spored (Fig. 67, *5, 6*).

Growth is good on all media tried—solid or liquid. In dark or light, pigment varies from rose to vermilion. No pellicle or cloudiness on liquids. Gelatin not liquefied.

Saccharomyces anginae Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 735, 1901.

Saccharomyces sp. Troisier & Achalme, Arch. Méd. Exp. **5**: 29-37, 1893.

Cryptococcus anginae Clerc & Sartory, C. R. Soc. Biol. **64**: 136, *2 figs.*, 1908.

Isolated in exudate from sore throat following typhoid fever. Lesions had general appearance of thrush.

Cells in exudate 8-9μ in diameter, in groups of 6-8 among epithelial cells. On peptone gelatin, at 20° C., ascospores produced abundantly, usually 4 to an ascus, spherical or ovoid (Fig. 68). On malt extract gelatin, asci more elongate, the 4 ascospores being in a row (Fig. 68, *6-8*). No chlamydospores on Nägeli mineral medium.

On agar, colony thick, rounded, grayish rose. On carrot (cooked), the same. Colonies, on peptone gelatin, both deep and superficial, the latter slightly grayish white and shining, the former brownish, spherical, surrounded by rays. On malt extract, no pellicle, turbidity clearing in 3 days, sediment thick, glutinous, brownish, having the odor of beer yeast. Sucrose fermented with a pleasant odor resulting. No acetic acid or aldehyde demonstrated.

Saccharomyces Ferrani Froilano de Mello, Paes & Sousa, Arq. Hig. Pat. Exot. **6**: 17-40, 1918.

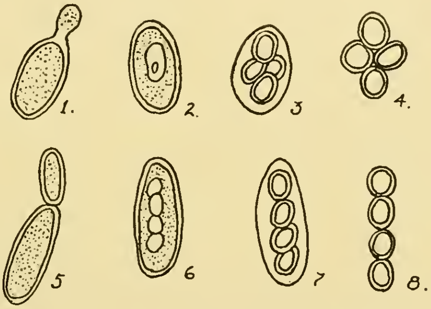

Fig. 68.—*Saccharomyces anginae.* (After Vuillemin & Legrain 1901.)

Isolated from the pus of large cold abscess in the axilla with metastases. In this pus were yeast cells varying from 1-5μ in diameter. Cells spherical, with 1-2 refringent granules, solitary or in groups of 2-80 individuals, with pseudomycelium but no true mycelium. Asci numerous, 2-4-spored, ascospores spherical or subreniform.

Grows on potato only, of the large number of media tried. Colonies ochraceous yellow, with center becoming chocolate colored and margins yellowish brown.

Saccharomyces Hagiwarae Dodge, n. sp.

Hefe Hagiwara, Jap. Zeitschr. Derm. Urol. **22**: 941-980 [77-78], *Pls. 19A-19B*, 1922.

Original lesion followed a bee sting behind the ear, later lesions on arms and axilla. Pathogenic to mouse, not to rabbit.

Yeast cells spherical or ovoid, 2.8-6.4 × 1.9-5.6μ. On gypsum block after 53 hours, asci produced, 2-4-spored. No mycelium figured or described.

Colonies round, brownish gray, moist, shining, center slightly elevated, with radiations at the margin. Optimum temperature 17-20° but growth possible between 0° and 55° C. Fermentation of maltose, dextrin, dextrose, fructose, galactose, lactose, sucrose, etc.

The figures are poorly reproduced, but those showing spores are quite plausible.

Saccharomyces tumefaciens Castellani & Chalmers, Man. Trop. Med. ed. 2, 768, 1913.

Saccharomyces subcutaneus tumefaciens Curtis, Ann. Inst. Pasteur **10**: 449-468, 1896.

Isolated from myxomatous tumor and lumbar abscess. Pathogenic for rat, mouse, rabbit, guinea pig, and dog.

On acid peptone broth, cells are ovoid or spherical, 3-6μ in diameter, wall thick, one to two refractive granules to a cell, no capsule. On sugar media, cells larger and in chains of 3-4 cells. Spores are spherical, 1-4 per ascus.

Colony on potato, creamy, becoming brownish. On potato and glycerol, colony creamy, abundant. Growth from gelatin streak in creamy elevated spots. Feeble development in broth, with light floccose sediment. No growth on serum. No veil on liquid media. Glucose and sucrose fermented, not lactose or maltose. Gelatin not liquefied.

Saccharomyces Blanchardi Guiart, ? Précis Parasitol. 1910; Castellani & Chalmers, Man. Trop. Med. ed. 2, 768, 1913.

Saccharomyces sp. Blanchard, Swartz & Binot, Arch. de Parasitol. **7**: 489-507, 1903.

Isolated from a gelatinous mass weighing a kilogram which was taken from the peritoneum in the vicinity of the appendix. Cultures from this mass gave principally this species. A rabbit, inoculated with this organism, died in about a week from diarrhea, but showed no peritonitis. Masses of the yeast were found in the kidneys. Also fatal to rats, mice, guinea pigs, and marmots, but not to hens or pigeons.

Cells spherical, 4-10μ rarely up to 20μ in diameter, rarely in chains, often with several cells united in a common capsule whose gel is frequently as thick as the cells themselves. After a week on sugar agar, asci appear. These have thick membranes, are 8-spored, the spores 3μ in diameter.

On sugar agar, at 22° C., growth slow, colony appearing after 5-6 days, attaining size of a lentil after 3 weeks, and at one month diameter of only 2 cm., opaque yellowish white or clear gray, surface granular with irregular contour, edges thick; with age, colony gradually becomes browner. On ordinary agar, growth is scanty and even slower, otherwise similar. Growth on potato slow but abundant, being several millimeters thick in a month, colony yellowish white, becoming verrucose and clear brown. On carrot, colony abundant and viscous. On potato glycerol, growth more rapid than on potato, colony gelatinous, clear yellowish white. On gelatin plates, colony whiter, more regular, round or festooned, and of a varnished appearance. Streaks on gelatin grow more slowly and less abundantly than on agar, are grayish white and of a mucous consistency. Almost no growth on coagulated serum. After 4 days at 37° C., in bouillon, there is a sediment, but the liquid is clear. No fermentation with sugars. Gelatin slowly liquefied.

Saccharomyces Lemmonieri Sartory & Lasseur, C. R. Soc. Biol. **78**: 48-49, 1915; Bull. Sci. Pharmacol. **23**: 151-157, 1916.

Isolated from a case of bronchitis and pulmonary congestion. Pathogenic to guinea pigs, white mice, and rabbits.

Cells 3.1-3.5μ in diameter, in age slightly elongate and clinging together in short chains. In deposits only spherical cells found. On plaster block and filter paper soaked in lactose solution, asci formed. These are 4-spored, the spores being 2.5-3μ in diameter.

On Sabouraud agar, colonies punctiform, nonconfluent, white, dull. Crenate margins 2-3 mm. high. At thirtieth day, colonies become chocolate brown. On potato, colonies white, punctiform, confluent, center elevated and acuminate, margins smooth. In age, colony cream white, becoming chalky on desiccation. On carrot, thick creamy colonies cover whole surface in a week. On gelatin, growth is slow. On egg albumen, smooth punctiform colonies with smooth borders appear on the ninth day. In broth with peptone, glycerol, and glucose, growth rapid, pellicle quite thick, ring rather fragile, liquid turbid, clearing with a sediment 2 mm. thick in 3 weeks. Sucrose inverted, glucose, fructose, sucrose, and maltose fermented; no action on lactose, galactose, inulin, starch, or mannite. Milk coagulated on tenth day, curd digested by the eighteenth. Liquefaction of gelatin begins on the eighth day.

Saccharomyces Zimmeri Dodge, n. sp.

Saccharomyces sp. Sartory, Sartory & Meyer in Zimmer, Weil, Sartory, Sartory & Meyer, Arch. Derm. Syphilis **167**: 211-221, *7 figs.*, 1932.

Isolated from abscesses from the gluteal region and upper thigh of woman in Alsace. Pathogenic for guinea pigs.

Cells ellipsoid, 4-5 × 2-3μ, forming chains up to 30μ long. Ascospores in pus and on gypsum block, cultures smooth, 1.25μ in diameter. Asci formed without copulation, and ascospores germinate directly.

On potato agar and Sabouraud glucose agar, colonies white, homogeneous with smooth margin, center becoming verrucose with yellowish Bröckelchen and radial furrows, finally grayish. On gelatin, colony spreading. On Meyer's liquid medium, gray flocculent sediment and a pellicle after 3 days at 37° C.; this later sinks and a new one forms. Optimum temperature 27°-35° C., optimum pH 5.8. Glucose, maltose, and sucrose strongly fermented and acidified, no action on fructose and lactose. Coagulated albumin unchanged. Milk coagulated but not digested in 8 days. Gelatin not liquefied.

Saccharomyces Sternoni Sartory, Sartory, Sternon & Meyer, Bull. Acad. Méd. Paris **107**: 120, 121, 1932.

Isolated from lesions in interdigital mycosis. Lesions reproduced on skin of guinea pig.

Cells spherical, 2-2.5μ in diameter, thin-walled, budding. Asci spherical to ovoid, 3.75-4μ in diameter, each containing 4 ascospores, 1.25-1.5μ in diameter. No copulation observed. In the scales, the intracellular parasite shows thin-walled cells.

On beef agar, potato agar, and Raulin agar, growth is good but less abundant, colony dirty white. Growth poor on serum and egg albumen. On potato juice, growth is good, pellicle shining white, thick. On Raulin acid medium, a pellicle forms after 12 hours and falls to the bottom the next day. Growth not luxuriant. A pellicle forms in milk on second day. Invertase secreted, maltose fermented with evolution of gas. No action on lactose and levulose. Milk not coagulated. Neither gelatin nor coagulated serum nor egg albumen liquefied.

Saccharomyces labialis Ribeyro, Anal. Fac. Med. Lima. **2**: 122-127, *2 pls.,* 1918.

Isolated from lesions on the lips of a young woman. Lesion on lower lip worst, involving region adjacent to mucous membrane. Abscess in guinea pig reproduced by inoculation.

After growth for 24 hours at 37° C., in ordinary or glucose agar, cells were predominantly 4-6μ in diameter with some smaller ones, 3-4μ. After 12-15 days, ovoid asci, 7-8μ with 4 ascospores to each. Ascospores fairly thin-walled. No mycelial forms seen.

On agar, growth abundant, colony dull white. Growth on potato good, colony elevated, opaque, white. On beet, growth good, colony dark and oily. Growth also good on carrot, colony oily and white. On sweet potato, growth poor, colonies white, slowly yellowing. On gelatin, growth is mediocre, colonies white, elevated, folded. Colonies on beef serum white and of the appearance of porcelain. These do not darken with age. On hay infusion agar, growth is scarce, colonies yellow white. In broth an abundant sediment forms. In broth, to which maltose has been added, growth is good, the liquid is turbid, and there is some sediment. In broth and glucose, levulose, sucrose, or mannite, growth is abundant, pellicle and sediment formed. With glucose and levulose, acid is formed, with the other sugars slight. Medium is turbid. In broth plus dextrin, inulin, or lactose there is less growth, medium remains clear and sediment settles out, no acidity. In milk, growth is fair, sediment forms. In a 1% aqueous solution of nutrose, growth is fair, liquid clear with some sediment. Glucose and sucrose fermented, not the others. Milk not coagulated, gelatin not liquefied.

Saccharomyces annulatus Negroni, Ann. Parasitol. Hum. Comp. **7**: 303-308, 1929.

Isolated from an abscess of the epididymis in Roumania. Pathogenicity not known.

Cells ovoid or ellipsoid, 3 × 4-6.5 × 11.5μ, on carrot (Fig. 69, *1*). On both carrot and Gorodkova agar, cells develop asci without copulation. Asci 1-4-

spored, most frequently 2. Spores spherical, smooth, flattened at the poles, about 3.5μ in diameter with a slight equatorial ring suggestive of *Williopsis Saturnus* (Fig. 69, *2*). Ascospores copulate in pairs within the ascus (Fig. 69, *3-7*). The nuclei usually fuse and sprouting begins from the copulation canal. Parthenogenesis is occasionally observed. The sexuality is at about the same stage as in *Saccharomycodes Ludwigii.* Optimum temperature for budding about 40° C., optimum for sporulation 28°, although both sprouting and sporulation occur at room temperature (14-17° C.).

On malt agar, colony is dirty white, creamy in consistency, shining, moist. Giant colony attains diameter of 4 cm. in 1 month, grayish with some small, crateriform elevations in center. Malt extract becomes cloudy with a deposit after a few days and a ring at the surface. Glucose, maltose, lactose, galactose, and raffinose fermented, sucrose and xylose slightly, without inversion in the case of sucrose. Fermentation of lactose denied by Dekker (1931). Gelatin not liquefied.

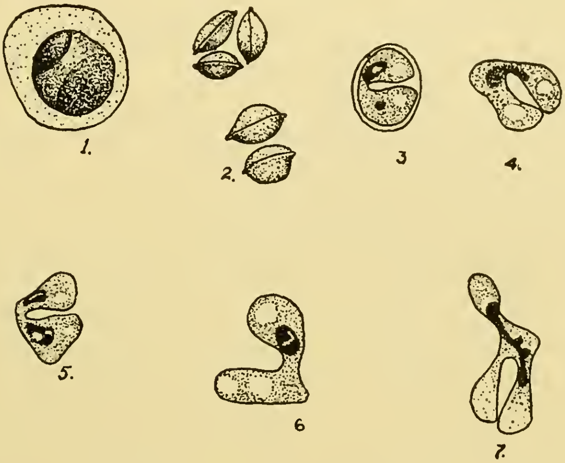

Fig. 69.—*Saccharomyces annulatus.* *1*, sprout cell; *2*, ascospores; *3-7*, stages in copulation. (After Negroni 1929.)

Dekker (1931) denied the existence of the equatorial ring on the ascospore, although she admitted she had observed one after staining with iron hematoxylin. This she claims to be an artefact and reduces this species to synonymy with the common beer yeast *S. cerevisiae,* although she does not report this ''artefact'' on spores of the latter organism.

Saccharomyces Jadini Sartory, Sartory, Weill & Meyer, C. R. Acad. Sci. **194**: 1688-1690, 1932.

Isolated from abscesses on buttocks. Pathogenic to guinea pig.

Cells 4-5μ in diameter, asci 3.75 × 5μ; ascospores 2 or 4, about 1.25μ in diameter. On solid media, some hyphae produced, 1.25-2.5 up to 25-30μ long. Asci also produced from these forms on gypsum blocks.

On solid media, white colony, with smooth margin and rough elevated center, color darkening on aging. On liquid media, pellicle evanescent. Glucose and maltose fermented, no action on lactose and fructose. Milk coagulated and not digested, egg albumen and gelatin not liquefied.

Doubtful Species

The following species referred to *Saccharomyces* and rather imperfectly described, seem anomalous in this genus and may belong near *Bargellinia* or *Debaryomyces.*

Saccharomyces pseudotubercolaris Santori, Riforma Med. **19**: 281-283, 1903.

Saccharomyces infiltrans Casagrandi, Ann. Ig. Sperim. N. S. **9**: 141-155, 1899; Riforma Med. **19**: 281-283, 1903 (nomen nudum).

Isolated from pseudotubercular lesions resembling sarcoma in the abdominal cavity of fowl. Pathogenic to laboratory animals.

Yeast cells spherical to ovoid, 1.5-2μ. On old cultures on solid media and in some liquid media, elongate ellipsoid cells occur in chains of more than 3 cells. Asci thick-walled, 2-4-spored.

On acid glucose agar, colony humid, white, thick, opaque, surface rough, margins sinuous lobed. On alkaline agar, colony shining, white, thinner. On gelatin, colonies whitish, moist, circular with irregularly lobed margins. On potato, colonies whitish, thick, at first moist becoming dry, surface first smooth becoming rough with sinuous lobes. On sugar broths, sediment formed but no ring or pellicle. No production of pigment, no hydrolysis of starch, no inversion of sucrose or amygdalin. No fermentation of sugars, milk not coagulated, gelatin not liquefied.

Perhaps the following unnamed organism should be referred here.

Saccharomyces sp. Darmagnac & Barletti, Bull. Soc. Centr. Méd. Vét. **68**: 157-163, *5 figs.,* 1914.

Isolated during an epizootic of turkeys, causing rapid death with primary lesions on the lungs and liver, occasionally also on the peritoneum, intestines, kidneys, and the myocardium. Yeast cells found in pseudotubercular lesions.

Yeast cells 6-10μ in diameter, while in old cultures cells elongate, tending to form a pseudomycelium. After two months, certain cells enlarge and contain ascospores(?) (figured as 2 per ascus). On plaster blocks these forms appear in a few days. The filaments are of irregular diameter and apparently form chlamydospores.

Colonies on glucose glycerol agar, whitish, creamy, not very adherent. On Sabouraud agar, white circular colonies, surface slightly convex. Colony on potato white, shining, creamy, becoming brownish in age. Flat, grayish colony on carrot. On gelatin, good surface growth. In broth, sediment on sides and bottom of tube, liquid remaining clear. Under anaerobic conditions, growth very slow and colony not characteristic. Gelatin not liquefied.

CHAPTER XIII

SACCHAROMYCETACEAE IMPERFECTAE

In this group of organisms, whose perfect stages are unknown, we have practically the same situation as we found in the Eremascaceae Imperfectae. In this group *Cryptococcus* occupies a position corresponding to that which *Monilia* occupied in the other. Fortunately for our purposes, fewer genus names have been proposed and of the small genera segregated, few have any relationship to disease. We have very many poorly described species, especially those reported to have some relationship to tumors, during the period when yeasts were regarded as etiologic agents in the production of hyperplasias. Some may have been based on artefacts (especially those which were not cultivated), and the others were perhaps contaminants, probably unimportant in relation to disease, but nevertheless apparently definite species, although poorly described.

Key to Genera

- Cells with vestigial copulation canals. *Asporomyces.*
- Cells without traces of copulation.
  - Cells small, often flask-shaped, not easily isolated on ordinary media (see p. 358). *Malassezia.*
  - Cells larger, cultivable on ordinary media.
    - Cells apiculate to citriform, producing a small ring with small, moist, thin, floating islets which may coalesce to form a very fragile moist pellicle, easily sinking, gelatin liquefied, fermentation present. *Pseudosaccharomyces.*
    - Cells rounded, not apiculate.
      - Cells producing abundant microblastospores, producing slight ring, gelatin liquefied, fermentation present. *Microblastosporion.*
      - Cells multiplying by ordinary sprouting.
        - Cells thick-walled, often embedded in a gelatinous matrix, pellicle thick, formed by the confluence of slimy floating islets when present, sediment slimy, gelatin not liquefied, or liquefied very slowly.
          - No fermentation. *Cryptococcus.*
          - Fermentation present. *Atelosaccharomyces.*
        - Cells thin-walled, not embedded in a gelatinous matrix, pellicle commonly present, gelatin liquefied.
          - Young cells with oil globules, pellicle slimy, sugars fermented. *Eutorula.*
          - Young cells without oil globules, pellicle dry, fragile, with slight folding, little or no fermentation of sugars, colonies usually pink or reddish. *Torulopsis.*

CRYPTOCOCCUS

Cryptococcus Kuetzing, Algarum Aquae Dulcis Germanicarum Decas III, No. 28, 1833.

Torula Turpin, Mém. Acad. Sci. [Paris] **8**: 369-402, 1838 p.p., non Persoon, 1796.

The type species is *Cryptococcus mollis* Kuetzing. The type of *Torula* Turpin non Persoon was *Torula cerevisiae* and probably included sporogenous as well as asporogenous strains.

Recently Ciferri & Redaelli (1929) have published a partial review of the literature relating to the difficult group of organisms which may be roughly designated as imperfect yeasts. It is unfortunate that such a paper should have been written without access to much of the pertinent early literature of the group, some of which apparently was known to them only from secondary sources, while some of the more important papers were entirely overlooked. This is especially unfortunate in the case of *Cryptococcus,* since very many nomenclatorial changes would be necessitated if their statements were accepted without careful examination.

The genus *Cryptococcus* was first established by Kuetzing in his *Algarum Aquae Dulcis Germanicarum Decas* III. No. 28, 1833, with a repetition of the diagnosis and discussion of its habitat in Linnaea 8: 365, 1833, in which he cites his earlier work of the same year. The genus is characterized as follows: *Globuli mucosi hyalini non colorati microscopici in stratum indeterminatum mucosum facile secedens sine ordine aggregati.*

Cr. mollis Ktz. "An feuchten und schmutzigen Fenstern."

The description is accompanied by a specimen dried to a small square of glass. The fungus consists of hyaline thin-walled spheres. There is also present, obviously as a contaminant, a small amount of a slender mycelium with small, very slightly colored, thick-walled spores, probably a saprophytic species of *Absidia* which agrees with the specimen of his *Leptomitus Plumula* issued in Decas 1, No. 9. The exact habitat is not given but, judging from his citing of this species found in conjunction with his *Leptomitus Plumula,* it seems probable that it comes from dirty windows, always in shadow from the building opposite, in the courtyard of an inn in Herbsleben, a hamlet of Gotha in Germany. Kuetzing, still laboring under the misconception of the polymorphism of these groups, thought that his *Cryptococcus* was close to the primordial slime of the philosophers and that various higher forms might develop from it, for he mentions one case in a well-lighted window on which *Oscillatoria* developed and gradually replaced the *Cryptococcus* colony. Since, in general, the species of *Oscillatoria* require a considerable amount of organic nitrogen for their active development, it seems quite likely that the habitat where he found his *Cryptococcus* (in water of condensation on windows of farmers' living rooms and inn yards) might easily have been contaminated by dirt from the stables. This supposition is also strengthened by the presence in the type collections, of tiny brown particles of dirt, which under the microscope appear to be bits of dung. Hence, it is quite possible that from the first this genus name, *Cryptococcus,* has been associated with an imperfect yeast from the intestinal tract, if not with some more active parasite of the domestic animals.

Kuetzing next added a new species in his article in Erdmann's Jour. Prakt. Chem. 1: 475, 1834. This species, *Cryptococcus infusionum,* was described as causing a deposit in, and discoloration of, rhubarb infusions. Methods for its control were elaborated. No pellicle is mentioned and no evolution of gas.

In 1843, Kuetzing treats the genus in his *Phycologia generalis,* pp. 147-149. Here he definitely recognized *C. fermentum* previously discussed but not mentioned by name in

Jour. Prakt. Chem. 11: 1837. He cites *Mycoderma cerevisiae* Desmazières, Ann. Sci. Nat. Bot. 1, 10: 59. *Pl. 3, Fig. 17,* 1826; and *Torula cerevisiae* Turpin, Mém. Acad. Sci. Paris, 8: 369-402, 1838, as synonyms. He also transfers to the genus his own *Micraloa rosea* (Linnaea 8: 371, 1833) found on decaying plants of *Chara.* He recognizes his previously described species (*C. mollis*), and changes the name of his *C. infusionum* to *C. Rhei,* describing as new *C. Valerianae* on valerian water and *C. inaequalis* on aqueous extract of *Calamus* and orange bark.

In 1849, Kuetzing again treats the genus in his *Species Algarum,* pp. 145-147, where he takes up the earlier specific epithet of the beer organism as *C. cerevisiae* (Desm.) Ktz. and transfers his own *Protococcus nebulosus* to *Cryptococcus.* He describes as new: *C. natans, C. carneus, C. coccineus, C. brunneus, C. vernicosus,* and *C. vini.* As this work is intended as a compilation and several of the new species were described from dry material found in various herbaria, the obviously discordant elements need not concern us here. He still clings to the idea that the typical members are spherical, slimy, and found in very moist habitats.

In the revised and greatly enlarged edition of his thesis published in 1853, Robin recognized *C. cerevisiae* (Desm.) Ktz. and *C. guttulatus* Robin, the latter having been previously described without a name by Remak (1845) from the intestinal tract of a rabbit.

In 1851, Fresenius described *Cryptococcus glutinis,* one of the pink yeasts. In the succeeding decades, the generic name fell into more or less disuse, owing to lack of interest on the part of mycologists and also to the misconceptions of Persoon's *Torula* and *Mycoderma* by Desmazières, Turpin and Hansen. Saccardo, for example, in his monumental work includes both the ascosporic yeasts and the asporogenous forms in his genus *Saccharomyces.*

In 1901, Vuillemin revived the name *Cryptococcus* for the asporogenous, nonfermenting yeasts from animal substrata, and since then the name has had practically universal use by the medical profession. Guilliermond (1912, 1920) recognizes *Cryptococcus* sensu Vuillemin but in his *Clef Dichotomique* (1928) reduces it to synonymy with *Torula* Hansen non Persoon. Ciferri & Redaelli (1925 et seq.) have attempted to transfer the species to *Torulopsis* Berlese (1894) and *Eutorulopsis* (*Eutorula* Will 1916).

From the foregoing discussion it will be seen that *Cryptococcus* should be used for a residue of species after other valid genera have been removed and may be characterized as follows:

Cells spherical, ovoid, or ellipsoid, occurring singly or held in more or less irregular groups by the secretion of thick, gelified capsules, especially in old age. Not forming ascospores, mycelium or pseudomycelium. On liquid media, pellicle thick, formed by the coalescence of slimy, floating islets when present, sediment usually slimy. No fermentation and acidity rare with carbohydrates. Liquefaction of gelatin very slow when present.

Besides miscellaneous organisms, mostly imperfectly described and quite possibly belonging elsewhere, two groups of organisms stand out as comprising the principal pathogens of this genus. One is a group of organisms isolated from tumors and intensively studied while the yeast theory of the origin of cancer was in the ascendant and utterly ignored since that theory was discarded. Whether the cause of the disease or no, they are interesting biologically and need more work. The other important group includes species centering about *C. histolyticus,* which have been repeatedly proved to be the etiologic agents of "Torula" meningitis whose literature, clinical manifestations, and pathology have been so thoroughly covered by Freeman (1931). This disease with 100% fatality is occasional in Europe and America, although it probably is much more common than the number of cases in the literature would indicate.

Freeman (1931) summarizes its features as follows: The onset is accompanied by headache that becomes progressively more persistent and severe, associated with stiffness of the neck and pain in it and in the limbs, and with nausea and vomiting. Disturbances in sleep, amblyopia and diplopia are next most common and mental phenomena, suggesting organic disease of the brain, follow. This syndrome occurs in an individual whose bodily functions are not otherwise upset and suggests some primary disturbance in the central nervous system, either chronic meningitis, atypical epidemic encephalitis, or unlocalized neoplasm. The frequent association of these symptoms in an individual who has definite indications of some chronic respiratory infection or lymphatic enlargement usually leads to the tentative diagnosis of tuberculous meningitis.

No treatment so far attempted seems to have had any fungistatic effect on the organism, although frequent lumbar punctures to reduce intracranial pressure bring temporary relief of the mental state and a highly nutritious diet (up to 5,000 calories), by tube if necessary, has prevented the extreme emaciation which has usually accompanied this disease. Indications of involvement of other portions of the body are unusual.

Necropsy reveals a granulomatous meningitis, usually most marked about the base, bearing some resemblance to tuberculous meningitis. The cerebral subarachnoid fluid and the ventricular fluid are often turbid and even slimy or gelatinous. In over half the cases there is also an invasion of the cerebral cortex that appears as blisters or pits, in the more advanced cases like soapsuds. The contents are clear to turbid, gelatinous and do not flow out when they are cut across. Discrete granulomata are occasionally encountered, spherical with compression of the surrounding tissues. The cerebellar meninges are often invaded, but the parenchyma less so, although the white matter may show mottling or even fissures.

Microscopically there appear to be three types of lesions, meningeal, perivascular, and embolic. The intracerebral lesions may be either cystic or granulomatous and are associated with varying degrees of inflammatory infiltration. The meninges show diffuse or focal granulomatous lesions with endothelial hyperplasia, fibrosis, moderate round cell infiltration, and a number of foreign body giant cells. Organisms are usually numerous. There is seldom any inflammatory reaction in the cerebral substance, although endothelial hyperplasia may be pronounced. The cysts are due to enormous collections of organisms with their surrounding mucoid capsules, often associated with very little reaction on the part of the mesodermal elements. The granulomata are due to large aggregations of endothelial cells, many of which have phagocytized the invading organisms. The mottling observed in the fresh specimen is due to vast disruption of the parenchymatous elements. The larger granulomata have delicate fibrillar reticulum but consist mostly of the organisms in large aggregations. The organism penetrates from the meninges along the perivascular sheaths of the vessels, forming flask-shaped cysts in the upper layers of the cortex. In some instances the cyst formation is very widespread (as in ''soapsuds'' cases), and subsidiary cysts are encountered. In other instances the cysts remain more or less single. Deeper in the cortex there are other cysts and granulomata that appear to have arisen through embolism. Capillary emboli are occasionally found consisting of *Cryptococcus* cells. The gray matter is particularly invaded, and small foci are often found about the aqueduct and fourth ventricle.

Of the other organs in the body, the lungs are most frequently invaded; very rarely the infection is generalized, even involving the skin. In these cases a more pronounced inflammatory reaction is present in these other organs, probably due to the normally greater amount of mesodermal tissue present. The portal of entry is never the skin but is probably the respiratory tract, either the lungs, the tonsils, or the sinuses.

Most work on this disease has been based on the clinical and pathologic sides and comparatively little on the organism. Stoddard & Cutler (1916), under the guidance of Wolbach, first brought the pathologic picture to general attention, but they did not attempt to isolate the organism from their cases and based their experimental work on species of this genus isolated more than a decade from lesions in the lung of a horse, assuming that an organism which produced a pathologic condition in experimental animals similar to that they had found in man, must necessarily be the same species as that which had produced the disease in man. Harrison, from a study of a number of strains isolated from human cases, found somewhat different cultural and biochemical characters with the same pathologic conditions. For want of a name I have called his organism *C. meningitidis*. The work of Freeman (1931) indicates that there are probably three, or perhaps more, organisms which produced the same general pathologic condition, differing in minor respects, but until there is more careful correlation of pathologic condition and cultural characters, the nomenclature of this group must be unstable. Up to the present only about half the pathologists who reported cases have described cultures of the organism isolated, and not in a single case has it been adequately described, while the only adequate description is not accompanied by case histories or pathology.

Key to Pathogenic Species

Colony white, grayish or yellowish.
  Pellicle thick, cells spherical or nearly so.
    On potato, colony white; from respiratory tract. *C. Neveuxii.*
    On potato, colony gray or drab or slightly yellowish; producing tumor-like lesions. *C. neoformans.*
    On potato, colony yellowish brown; isolated from tumor. *C. Plimmeri.*
    On potato, colony very dark brown; isolated from tumor. *C. lithogenes.*

Pellicle thinner, only on malt and some sugar solutions; on potato, colony white or yellowish.	
Milk not coagulated, gelatin slowly liquefied.	
Sucrose inverted; from respiratory tract.	
Nitrate not assimilated.	*C. nasalis.*
Nitrate assimilated.	*C. rotundatus.*
Sucrose not inverted; from meningitis.	*C. meningitidis.*
Milk coagulated, acid with sugars, gelatin not liquefied.	*C. Gotoi.*
Action on milk unknown, gelatin slowly liquefied.	*C. hondurianus.*
Traces of pellicle on malt extract, otherwise pellicle absent.	
On potato, colony grayish; milk coagulated.	*C. conglobatus.*
On potato, colony yellowish; milk not coagulated.	*C. Kleini.*
No trace of pellicle or ring.	
No capsule; cells ovoid or spherical, 3-5 × 2.8-4.3μ; from respiratory tract.	*C. Guilliermondi.*
Capsule well developed; cells spherical, 3-7μ (in pus up to 30μ); eventually attacking the brain.	*C. psicrofilicus.*
Capsule well developed; cells spherical, mostly 3-4μ (in pus up to 13μ); attacking the brain.	*C. histolyticus.*

Cryptococcus Neveuxii Vuillemin & Lasseur aput Servet, Thèse de Nancy 108 pp., 1922; Lasseur & Servet, Rev. Méd. de l'Est **50**: 357-370, 1922.

Torulopsis Neveuxii Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from a case resembling tuberculosis, which yielded quickly to medication with KI; Grand Bassam, Ivory Coast.

On potato, colony white, moist, then showing dull islets which spread, giving colony a chalky appearance, margins sometimes festooned. No asci on carrot. On glucose agar, colony as on potato except it is finally folded. On artichoke, colony thick, granular, green. In glucose peptone, pellicle thick, folded, white, climbing up the tube for 4-5 mm., sediment white and liquid clear. No fermentation. Acid production with glucose, fructose, maltose, galactose, lactose, and xylose.

Cryptococcus neoformans (Sanfelice), Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 747-750, 1901.

Saccharomyces sp. Sanfelice, Centralbl. Bakt. **17**: 113-118, 625-634, 1895.

Saccharomyces neoformans Sanfelice, Ann. Ig. Sperim. **5**: 239-262, *Pls. 9-10,* 1895.

Torula neoformans Weis. Jour. Med. Res. **7**: 280-311, *Pls. 21-24,* 1901.

Blastomyces neoformans Arzt. Arch. Derm. Syphilis **145**: 311, 1925.

Torulopsis neoformans Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from the surface and juice of a peach but found pathogenic for laboratory animals upon inoculation. [Weis gives additional information based upon subculture received from Sanfelice.] Lodder (1934) referred here a culture received from Voss as *C. hominis.*

In young cultures cells spherical, 4-18μ, capsule very delicate with occasional vacuoles and numerous oil drops. In older cultures, cells spherical or ovoid, 2-22μ, with irregular and distorted forms. Large vacuoles present, capsules more conspicuous. Cell division in all planes; no ascospores.

On malt agar, colony whitish, translucent, elevated, becoming opaque, yellowish white, margins beveled, finally yellowish brown and up to 6 mm. thick. On malt gelatin, colonies confluent, flat margins elevated, centers slightly depressed, surface dull, smooth, waxy, yellowish white. On blood serum, colonies milk white, elevated, slightly slimy, glistening becoming yellowish, drying chalky, resembling daubs of white paint. On potato, colony elevated, margins regular, verrucose, white or slightly yellowish becoming gray or drab. On malt extract, liquid clear, sediment abundant, granular to flocculent, ring well developed, pellicle very finely granular or cheesy, becoming thick. On glucose broth, little or no pellicle, sediment grayish white. No action on milk. Gelatin not liquefied (Sanfelice) or slowly liquefied after a week, becoming complete in 5-6 weeks (Weis).

Cryptococcus Plimmeri (Costantin) Neveu-Lemaire, Parasitol. Anim. Domest. 60, 1912.

Saccharomyces sp. Plimmer, Centralbl. Bakt. **25**: 805-809, 1899.

Saccharomyces Plimmeri Costantin, Bull. Soc. Myc. France **17**: 147, 1901.

Torula Plimmer Weis, Jour. Med. Res. **7**: 280-311, *Pls. 21-24,* 1902.

Torulopsis Plimmeri Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Found in about half of a series of cancer cases examined by Plimmer. Pathogenic to guinea pig in both intraperitoneal and subcrural injections.

In pellicle of young cultures, cells 4-8μ, without capsules, vacuolate with many oil globules. In sediment, cells larger, 2-10μ, capsules on very large cells, not on small ones. In old cultures, cells 2-16μ with 1-3 large vacuoles, capsules highly developed; cells in chains of 3 cells, the middle cell usually smaller; cell division in one plane only; no ascospores.

On malt agar, colony whitish, translucent, elevated, becoming radially furrowed and zonate, center pure yellow with white margin. On malt gelatin, colonies confluent, smooth, center not depressed, margins not elevated, white, then yellowish. On blood serum, growth slight, whitish, flat, giving the appearance of daubs of paint. On potato, colony yellowish brown, surface convoluted, margin regular. In malt extract broth, liquid clear, pellicle delicate not settling to the bottom, sediment cheesy to coarsely granular, highly developed, ring heavy, opaque. In glucose broth, pellicle well developed at 25°, little or none at 37° C.; sediment very slight. Growth good in litmus milk but no change in medium. No fermentation of sugars. Gelatin not liquefied (Plimmer), very slowly liquefied after one week, becoming complete in 5-6 weeks (Weis).

Cryptococcus lithogenes (Sanfelice) Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 739-741, 1901.

Saccharomyces litogenes Sanfelice, Centralbl. Bakt. I, **18**: 521-526, 1895.

Torula Sanfelice Weis, Jour. Med. Res. **7**: 280-311, *Pls. 21-24,* 1902.

Blastomyces lithogenes Sasakawa, Centralbl. Bakt. I, **88**: 274, 1922.

Torulopsis lithogenes Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from the lymphatic ganglia of an ox, which died of generalized carcinoma. Pathogenic for guinea pig and mouse, but not for sheep. (Strain studied by Weis was isolated from adenocarcinoma of human ovary by Sanfelice.)

In tissues cells spherical, variable in size, containing rounded or angular masses of calcareous material. In pellicle, cells spherical, 1-8μ, oblong and misshapen cells observed during active sprouting; capsules absent or extremely delicate. In sediment, cells 3-12μ with a capsule, protoplasm granular with oil drops and vacuoles. In old cultures capsules 1-1.5μ thick, cells often embedded in a mass of gel, many resting cells present; cells dividing in all planes, no ascospores present.

On malt agar, colony at first whitish, elevated, becoming opaque, yellow, center folded, margins even, sharply beveled. On malt gelatin, colonies confluent, flat, somewhat elevated at the margin with slightly depressed centers, surface dull, smooth, waxy, yellowish white. On blood serum, colonies white, elevated, slimy, glistening, yellow, growth scant, drying chalky, suggesting daubs of white paint. On potato, colony very dark brown, margin very irregular, surface glistening and corrugated. In malt extract broth, liquid clear, pellicle at first very delicate, later heavy and membranous; sediment slight until after fall of first pellicle, then heavy, cheesy, and flaky; ring well developed. On glucose broth, pellicle developed, white becoming yellowish, little sediment grayish white. No fermentation, no action on milk, gelatin not liquefied (Sanfelice) or slowly liquefied after one week, the action complete in 5-6 weeks (Weis).

Cryptococcus nasalis (Harrison) Dodge, n. comb.

Torula nasalis Harrison, Trans. R. Soc. Canada, Biol. Sci. **22**: 207, 1928.

Torulopsis neoformans race *nasalis* Lodder Anaskosporogenen Hefen **1**: 176, 1934.

Isolated from nasal tumor in horse by K. F. Meyer (1912).

In young colonies, cells spherical, average diameter 4μ. In 57-day-old cultures, cells still spherical, varying from 3.5 to 7μ in diameter (average 5μ), oil globules present. Growth good between 25° and 37° C.

On malt agar, growth is elevated, shining, spreading, and white, later darker in color and more massive. On potato, colony white, raised, dull, spreading, becoming darker in age. On malt gelatin, colony elevated, white, waxy, radiately striate, forming a funnel-shaped depression in 57 days. Giant colony is dull, white with slightly elevated and lobate margin and depressed center. Slight growth under olive oil. In malt extract, a creeping pellicle appears, then a heavy ring with cloudiness and thick sediment. No fermentation of sugars. Acid produced in glucose, fructose, mannose, mannite, xylose, maltose, sucrose, and dextrin; forming a pellicle and turbidity which clears as the sediment forms in all sugars except rhamnose, glycerol, and inulin. Sucrose inverted. Milk becomes alkaline without other change. Malt gelatin slightly liquefied in 57 days, ordinary gelatin in 26 days.

Cryptococcus meningitidis Dodge, n. sp.

Torula histolytica Harrison, Trans. R. Soc. Canada, Biol. Sci. **22**: 187-225, *5 pls.*, 1928.

Isolated from a case of cystic blastomycosis of the cerebral gray matter.

Cells spherical, even in size, averaging 3.5μ in diameter; on 56-day-old cultures 3-6μ in diameter, averaging 4.2μ; oil globules present, the older cells having a mucinous capsule.

On malt extract agar, growth is white and shining, slightly spreading, in age becoming yellow then brown, the growth more massive. In malt gelatin, colony white, waxy, elevated, with radiate markings, later forming a funnel-shaped depression. Giant colony is whitish, shining, slightly rugose, margin lobate, center slightly depressed. On potato, colony elevated, white, shining, and spreading. In malt extract, a ring and pellicle develop with turbidity and heavy sediment. Ring in solutions of maltose, lactose, sucrose, raffinose, salicin, and dextrin, none in glycerol, sorbite, or inulin. Under olive oil, capitate colonies form, growth slight. Grows well between 25° and 37° C. Sucrose not inverted. In acid sugar media (pH 5.2), pellicle, turbidity and sediment in glucose, mannose, galactose, fructose, and xylose. In milk, ring forms, reaction slightly alkaline, no coagulation. Gelatin liquefied in 26 days.

Lynch & Rose (1926) report slight liquefaction of gelatin after 3 months, also slight acidity in maltose (and after 3 months in sucrose). Rappaport & Kaplan (1926) report their organism to be gram-positive when young. Growth best on carbohydrate media and under low oxygen tension.

Cryptococcus rotundatus (Redaelli) Dodge, n. comb.

Torulopsis rotundata Redaelli, I Miceti come Associazione Microbica nella Tubercolosi Polmonare Cavitaria 46, 1925 (fide Lodder, Anakosporogenen Hefen **1**: 170-172, 1934).

Isolated from a case simulating tuberculosis of the lung.

Cells spherical 5-6.5μ in diameter, giant cells to 10μ. On malt agar, cells slightly ovoid.

On carrot agar, colonies white to slightly pinkish, surface dull. On malt agar, colonies yellowish, slightly reddish, humid, smooth, slimy, margin smooth. On malt gelatin, colonies yellowish, dull, center elevated, margin somewhat sinuous and slightly shining. On malt extract, a ring and sediment, the whole fluid becoming slimy.

Cryptococcus Gotoi Dodge, n. sp.

Hefe Goto, Mitt. Med. Fak. Univ. Tokyo **15**: 75-101, *Pls. 9-10*, 1915.

Isolated from a case of blastomycotic meningitis in Japan. Fatal for mice, rats, guinea pigs, and rabbits, but not for dogs.

Cells 3-6μ, walls thin when young, becoming very thick-walled when old. No mycelium or ascospores. Capsule well developed.

Colonies on blood agar very small, white, punctiform, moist, by transfer gradually accustomed to all the usual media. On malt (mizuame) agar, colonies moist, white, round, opaque, finally confluent and yellow, especially at room temperature. Growth poorer on ordinary agar, blood, glycerol, and ascites agar. On potato, colony moist, white, confluent. On broth and peptone solution, no pellicle, slightly granular sediment. On malt extract and sugar solutions, a ring develops, also turbidity and a yellowish white sediment. No fermentation; acid in arabinose, xylose, glucose, fructose, galactose, mannose, sucrose, lactose, maltose, raffinose, inulin, starch, dextrin, mannite, and erythrite. Milk coagulated in 10 days. Gelatin not liquefied in several weeks.

Cryptococcus hondurianus (Castellani) Dodge, n. comb.

Torulopsis hominis var. *honduriana* Castellani, Med. Press Circular **136**: 438-443, 1933; Jour. Trop. Med. Hyg. **36**: 311, *Fig. 36*, 1933.

Torulopsis neoformans Lodder, Anaskosporogenen Hefen **1**: 176-178, 1934.

Isolated from blastomycosis of the skin with pulmonary complications in Honduras.

Cells spherical, 3.5-10.5μ, occasionally ovoid. In malt extract, cells 3.9-5 × 4.5-5.5μ.

On glucose agar, colony smooth, mucoid, yellowish. No pigmentation of mannitol agar. On malt agar, colony yellowish, humid, smooth, slimy, margin smooth. On malt gelatin, colony dull, almost smooth, margin smooth. On malt extract, broad yellowish ring, well-developed sediment, and a few slimy floating islets. No fermentation and no acidity with carbohydrates except glucose, sucrose, xylose (and in one strain on glycerol). Serum not liquefied; gelatin liquefied very slowly after 2 weeks in one strain, in other not liquefied.

Cryptococcus conglobatus (Redaelli) Pollacci & Nannizzi, Miceti Pat. dell'uomo e degli Anim. **7**: No. 63, 1928.

Torulopsis conglobata Redaelli, I Miceti come Associazione Microbica nella Tubercolosi Polmonare Cavitaria, 1925.

Isolated from lungs with much destruction of tissue, in Italy. Later isolated by Carnevale-Ricci from tonsillar crypts. Subsequently found in several other cases in lesions of the lung.

Cells spherical or slightly ovoid, 1.5-3μ, occasionally up to 4.5μ in diameter, at first homogeneous then vacuolate and uniguttulate, solitary or in groups of 3-6 cells; on carrot, cells somewhat larger, 5-6μ; thick-walled chlamydospores, 5.5-6.5μ, present in old cultures but no mycelium. Chlamydospore wall rupturing on germination. No ascospores.

On Pollacci agar, colony thick, luxuriant, spreading, white, smooth, shining, margin smooth. Colonies on Sabouraud agar similar. On carrot agar, colony white, creamy, opaque, margin smooth or slightly striate. On Gorodkova agar, colony brown, opaque, easily separable from the substrate. On carrot, colony creamy, white, margins irregularly lobed. On potato, colony grayish, surface slightly irregular, thick and opaque, small. On malt gelatin, colony plane, yellowish, opaque, 3 cm. in diameter in 30 days, margin finely and irregularly dentellated. On malt extract, producing fragments of a milky white ring with traces of a pellicle floating on the liquid, with dirty yellow sediment. Milk coagulated.

Cryptococcus Kleini (Weis) Cohn apud Guéguen, Champ. Paras. Homme 114-115, 1904.

Torula sp. Klein, Jour. Hyg. **1**: 90-94, 1901.

Torula Klein Weis, Jour. Med. Res. **7**: 280-311, *Pls. 21-24*, 1901.

Isolated from milk along with other organisms. Pathogenic for guinea pig, rabbit, and dog, producing tumor in guinea pig in original case.

Cells spherical, 2-8μ in diameter, homogeneous in content, finely granular, thin-walled when young, finally surrounded with a hyaline capsule occupying about one-fourth the total diameter. On solid media cells secrete a mucinous sheath. Growth from 20° to 37° C.

On glycerol, malt, and sugar agars, colonies thick, viscid, yellowish. Colonies on nutrient agar remain white. On alkaline nutrient gelatin, colony thick, rounded, moist, center raised, white in reflected light, brown and granular in transmitted light. On sugar gelatin, growth more rapid, colony light yellow. After 5-6 weeks, gelatin slowly liquefied into a thick, turbid, syrupy mass. On blood serum, colony white gradually becoming yellowish, slimy, growth very slow. On potato, colony yellowish, surface convoluted, margins irregular. On malt extract, pellicle delicate, sediment flocculent to granular, ring well developed. In glucose broth, a slight pellicle and a powdery white sediment appear, the liquid remains clear. Growth on milk good, medium not coagulated. No fermentation of lactose, sucrose, maltose, or glucose.

Cryptococcus Guilliermondi Beauverie & Lesieur [name with reference to previous description], Jour. Physiol. Path. Gén. **14**: 998, *Pl. 11,* 1912.

Levure Guilliermond & Lesieur, C. R. Soc. Biol. **70**: 952-954, 1911.

Isolated from the lungs of a man dying with cancer of the kidney. Lung symptoms resembled tuberculosis without accompanying fever. Inoculations into guinea pig negative.

Cells spherical or ovoid, 3-5 × 2.8-4.3μ, solitary or in pairs, with a thick membrane but no capsule, possessing one or two vacuoles and numerous oil droplets. In fruit juices, cells 3.5-6.4μ in diameter, even larger in Raulin solution. In old cultures elongate cells may be seen. Sometimes, though rarely, these are branched. Giant cells common. No spores found in cultures on plaster blocks, Gorodkova agar, or slices of carrot.

On carrot, growth abundant, white even in old cultures, viscid. On potato, growth feeble, colonies size of pinhead, white, dry. On agars, grape juice, broth, peptone solution, growth is good, with viscid, yellow colonies; grayish in age. In other fruit juices, growth poor, sediment produced but no pellicle. Sugars are inverted, but there is no alcoholic fermentation.

Cryptococcus psicrofilicus Niño in Speroni, Llambias, Parodi & Niño, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **5**: 94-155, *35 figs.*, 1930.

Isolated from a nodulo-ulcero-scabrous dermatitis originally, with subsequent involvement of the prostate, gastritis, and meningoencephalitis, this latter the immediate cause of death about 3 months after the appearance of the first cutaneous lesion. Patient a native of Spain, resident twenty years in the Argentine. Pathogenic to rabbits, guinea pigs, white rats, and mice, with reproduction of lesions both microscopically and macroscopically.

Examination of pus from abscesses showed spherical yeast cells, very variable in size, 7-30μ, sprouting or not, possessing a thick, smooth double-layered wall, quite visible and enclosing a somewhat granular substance. Some cells have 2-4 granules, 1-2μ in diameter. Some large cells with thick, gelatinous, hyaline wall, 5μ or more thick. Cells solitary or in chains of 2, 3 or 4. Sometimes vacuolate with protoplasm along wall in ring or half moon and showing a few black corpuscles. Occasionally spore wall ruptures, allowing cell contents to escape.

Yeast cells were also encountered in the tissues. Under culture the organism always has appeared with spherical cells, 3-7μ in diameter, single or sprouting, with thick external membrane and somewhat granular content. Hyphae never seen. Gelatinous sheath never seen in culture. While in the pus, the organism was hard to stain, being gram-negative and only faintly tinted with Leishman and May-Grünwald-Giemsa stains; the cultivated organisms stain readily.

Optimum temperature 25°, little growth at 37° C.

On Sabouraud agar, abundant growth in 24 hours, colonies cream white, hemispheric, not confluent, humid above, not adhering to medium below. When growth is very abundant, culture appears dry and oily. Growth in plain agar similar, but less abundant. On poor nutritive agar, abundant growth in 24 hours. On potato, with 8% glycerol, good growth in 48 hours, colonies confluent, moist, grayish white, liquid without turbidity, with sediment at bottom of tube. On carrot with 8% glycerol, regular growth after 48 hours, colonies isolated, white, hemispheric, moist, sediment at bottom of tube with liquid clear. On coagulated human serum, growth scarce after 24 hours and poor thereafter, no color production or liquefaction. When inoculated by stab, growth scant at first. After 20 days infundibuliform growth and liquefaction at bottom. Scant growth also on coagulated albumen, with neither liquefaction nor pigment formation. On Gougerot gelatin (stab), surface growth at 48 hours, colonies flat, white with scalloped edge and moist surface. On Drigalski-Conradi medium, no growth in 76 hours. In plain broth or peptone solution or acid Raulin solution, after 48 hours poor, powdery growth along the walls of the tube and forming a scant sediment at the bottom, no turbidity and no pellicle. In Sabouraud broth, after 3 days, medium becomes turbid with abundant sediment and white pellicle which falls to the bottom after being shaken. Does not ferment any of the usual sugars, does not liquefy gelatin or coagulate milk.

It seems probable that the following organism should be referred here.

Torula sp. McGehee & Michelson, Surgery, Gyn. Obstet. **42**: 803-808, *6 figs.*, 1926.

Isolated from pus of an inguinal abscess with symptoms of gonococcemia in a negro woman, but all attempts to isolate *Neisseria gonorrhoeae* were unsuccessful. Highly pathogenic for guinea pigs and rabbits.

Yeast cells in pus 7-15μ in diameter, spherical or ovoid, walls thick, enveloped in a capsule. Gram-negative or nearly so, not acid-fast. Each cell with 1-5 spherical refractile granules. In cultures, morphology similar to that in pus, the gelified matrix appearing only in old cultures and holding the individual cells together in short chains. No ascospores.

On Sabouraud agar, colonies in 24 hours small, white, opalescent, round, becoming coarsely granular and hemispheric, then thickly mucoid and heaped up in the center, finally confluent and of varying shades of yellow and brown. On blood agar, colonies sparse, discrete, small, grayish white. On Löffler's blood serum, colonies similar but smaller and more watery. In broth, growth poor, forming a thick adherent sediment with a tendency to grow up the sides of the tube. No fermentation of sugars, no liquefaction of gelatin, no action on milk, no indol formation.

Cryptococcus histolyticus Stoddard & Cutler, apud Castellani Amer. Jour. Trop. Med. **8**: 393, 1928.

Torula sp. Frothingham, Jour. Med. Res. **8**: 31-42, *Pls. 3-4,* 1902; Türck, Deutsch. Arch. Klin. Med. **90**: 335-366, 1907.

Torula histolytica Stoddard & Cutler, Monog. Rockefeller Inst. Med. Res. **6**: 1-98, *9 pls.,* 1916; Ota, Ann. Parasitol. Hum. Comp. **2**: 41-43, 1924.

Torulopsis histolytica Castellani & Jacono, Jour. Trop. Med. Hyg. **33**: 316, *Fig. 44,* 1933.

Isolated from the lung of a horse by Frothingham (1902). Experimental inoculation by Stoddard & Cutler (1916) produced brain lesions similar to those in human brains caused by *C. meningitidis.* Perhaps organism of Voss (1923) should be referred here.

Cells spherical, 1-6μ in diameter (average 3-4μ), sprouting from the medium-sized cells. Capsule 0.5-1.0μ thick. No spores observed.

On glucose agar, colonies at first white, then more or less yellowish, heaped up, smooth, pasty, shining, thick. In broth, slight turbidity, no pellicle, fine white sediment. No fermentation of lactose, sucrose, dextrin, or glucose. No liquefaction of gelatin.

Doubtful Species

The following species of pathogenic yeasts have been too poorly described to place definitely.

Cryptococcus Breweri (Verdun) Castellani & Chalmers, Man. Trop. Med. ed. 2, 771, 1913.

Blastomyces sp. Brewer & Wood, Ann. Surgery **48**: 889-896, *Pls. 1-7,* 1908.

Atelosaccharomyces Breweri Verdun, Précis Parasitol. 1912; Froilano de Mello, Paes & Sousa, Arq. Hig. Pat. Exot. **6**: 34, 1918.

Saccharomyces Breweri Neveu-Lemaire, Précis Parasitol. 97, 1921.

Torulopsis Breweri Almeida, Annaes. Fac. Med. São Paulo **9**: 10, 1933.

Cryptococcus Copelli Neveu-Lemaire, 1921, referred here as synonym by Vuillemin, Champ. Paras. 96, 1931.

Isolated from two tumors on spine involving spinal processes, on Russian who had been in America for six months. Tumors removed and recovery complete. Inoculation into guinea pigs reproduced the human lesions.

Reproduction by sprouting only, with some chains.

Growth slow, small grayish punctate colonies after 48 hours on glycerol agar. On agar slants, heaped up, yellowish, creamy growths formed. On potato, growth heavy and white. Organism grows on litmus milk but causes no change. Gelatin not liquefied, perhaps because of slow growth.

Cryptococcus Costantini Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 294, 297, 1918.

Cryptococcus hominis var. *Costantini* Vuillemin.

Saccharomyces hominis Costantin, Bull. Soc. Myc. France **17**: 145-148, 1901.

Torulopsis Costantini Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Organism isolated from a tumor.

Does not become brown on potato. Membranes not thickening on ordinary media.

Cryptococcus Cooperi Dodge n. nom.

Cryptococcus quasi linguae pilosae Cooper, Am. Jour. Trop. Med. **12**: 97-100, 1932.

Isolated from a single case of lingua nigra out of 102 studied. Pathogenicity not reported.

Cells ovoid, 2-9μ long, producing only one sprout at a time.

Cultural characters not given. Acid produced with glucose, maltose, fructose, and galactose, also litmus milk. No fermentation. Pellicles produced in liquid media.

Since the name as published by Cooper is a polynomial, it is invalid. To shorten it to *linguae-pilosae* is impossible as that name already exists for another species. To hyphenate all three words makes an unnecessarily long name. Hence, I take pleasure in dedicating it to its author.

Cryptococcus Corsellii Neveu-Lemaire, Précis Parasitol. Anim. Domest. 60, 1912.

Blastomicete Corselli & Frisco, Ann. Ig. Sperim. **5**: 433-447, *Pls. 12-15,* 1895.

Isolated from a sarcoma.

Colonies small, more or less circular on gelatin, glycerol agar, or sugar agar. No growth on potato or fruit. Cells spherical, sprouting. Ascospores reported, but figures not very convincing. Description too inadequate for further identification. Notes on use of various stains in organism and in tissue.

Cryptococcus degenerans Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 740, 1901.

Blastomyces vitro simile degenerans Roncali, Centralbl. Bakt. **18**: 353-368, 1895.

Zymonema degenerans Froilano de Mello, Paes & Sousa, Arq. Hig. Pat. Exot. **6**: 33, 1918.

Torulopsis degenerans Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Pathogenic to guinea pig.

Cells spherical, isolated or united in groups in the tissue, thick-walled.

On potato, colonies are small, dry, elevated, grayish white, margins indented and wavy, cells double the size of those on other media. On gelatin, superficial colonies are yellowish gray and granular; those deeper are small, rounded, brownish. In glycerol or glucose broth, a powdery deposit appears. No fermentation of sucrose. Gelatin not liquefied.

Cryptococcus gracilioides Castellani, Jour. Trop. Med. Hyg. **28**: 220-223, 1925; Am. Jour. Trop. Med. **8**: 394, 1928; Mallardo, Jour. Trop. Med. Hyg. **32**: 145-147, 1929.

Monilia sp. Castellani, Jour. Trop. Med. Hyg. **28**: 8, 9, 1925.

Cells ovoid to flask-shaped, 3-4.5 × 2-3μ; gram-positive, not acid-fast.

On dextrose and on McConkey lactose agar, colonies small and similar to those of *Streptococcus*. Very scanty growth and no liquefaction of serum or gelatin. No fermentation. Darkening of lead agar.

Cryptococcus granulomatogenes Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 741, 1901.

Saccharomyces granulomatogenes Sanfelice, Zeitschr. Hyg. **29**: 498-501, 1898 (spelled *granulomatosus* in heading).

Torulopsis granulomatogenes Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from granuloma of lung of swine. Not pathogenic to laboratory animals but reproduced the disease when inoculated into swine.

Cells smaller than in *Cryptococcus neoformans*. No ascospores.

Colonies round, white on usual media, gray on potato, rose color on pear and honey. Thin pellicle and turbidity in glucose broth. Gelatin not liquefied.

Cryptococcus Jeanselmei Burnier & Langeron, Congrès Derm. Syphiligr. Langue Franç. **1**: 40, 41, 1922.

Torulopsis Jeanselmei Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from a case of interdigital pruritus with exfoliation.

Cells about 4μ in diameter, in age attaining 6μ. No mycelium or ascospores observed.

Colonies on maltose agar whitish, shining, smooth or mammillate at the center.

Cryptococcus mutilans Breuil, 1915; Neveu-Lemaire, Précis Parasitol. Hum. 79, 1921.

Reported as the cause of gangosa or rhinopharyngitis mutilans in the Pacific Islands. Not cultivated and inoculations negative.

Cryptococcus myrmeciae Chalmers & Christopherson, Jour. Trop. Med. Hyg. **17**: 129-135, 1914.

Torulopsis myrmeciae Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from extensive warts on the face.

In lesions, cells yeastlike, sprouting, 1.4 × 2.1μ in diameter. Not obtained in culture.

Cryptococcus psoriasis Rivolta, Paras. Veg. 464, 469, 1873 (fide Kraus).

Torulopsis psoriasis Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Seen in scales from psoriasis patients.

Cells spherical, thick-walled, sprouting, not producing mycelium.

Cryptococcus radiatus Sartory, Sartory & Meyer, C. R. Soc. Biol. **106**. 597, 598, 1931.

Saprophyte isolated during an epidemic in Alsace, the disease being characterized by falling hair.

Cryptococcus septicus (Gaetano) Dodge, n. comb.

Saccharomyces septicus Gaetano, Rif. Med. **13**: 3 :590-593, 1897.

Isolated from septicemia in guinea pig.

Cells mostly spherical, occasionally ovoid. No hyphae observed. Germination by sprouting. Optimum temperature for growth 20-30° C.

On gelatin, small, round, shining, milky white colonies. About the same on Casagrandi agar. Slower growth in neutral or alkaline media. In liquid cultures, no pellicle or turbidity, although sediment appears at the bottom of the tube.

Cryptococcus Burnieri Nannizzi, Tratt. Micopat. Umana **4**: 305, 1934.

Cryptococcus de Burnier (*cas S*) Ota, Ann. Parasitol. Hum. Comp. **2**: 47, 48, *Fig. 7,* 1924.

Isolated from case of epidermomycosis.

On malt extract, at 25° C., after one day, cells ovoid or slightly elongate, rarely spherical, slightly pointed at the ends, 4-5 × 2μ, solitary or in pairs, walls thin, slightly larger after a month, still solitary but becoming thick-walled, and on carrot reaching 7μ in diameter. On Gorodkova agar, cells elongate, 13 × 3μ, in small chains of 3-4 cells, no asci; sprouting bipolar.

On malt agar, colony cream color or grayish, surface smooth, shining, moist, margins definite. On malt extract, a slight ring and thick sediment.

Cryptococcus sp.

Hefe, Ota, Festschr. Keizo Dohi 335-350, *Pls. 32, 33,* 1917.

Isolated from two cases of cutaneous abscesses. Pathogenic to guinea pig, rabbit, and white rat.

Cells 1.4-4.5μ in diameter when spherical, or 4.9-6.2 × 3.1-2.9μ when oblong, thick-walled, granular.

On agar, colony thin, grayish white, slimy. On potato, a grayish white, thick membrane appears. Membrane consistency of "mizuame," with fine hyphae. Peptone solution, with or without sugar, remained clear. No acid or gas formed in presence of sugars, but alcohol was detected by iodoform test.

Perhaps this was the strain later sent to the Centraalbureau voor Schimmelcultures under the name *Cryptococcus hominis* and referred by Lodder (1934) as *C. neoformans.*

Cryptococcus sp.

Blastomyces sp. Escomel, Bull. Soc. Path. Exot. **8**: 90-92, 1915.

Isolated along with *Leishmania* in the disease called "espundia" in Peru. Started as cutaneous ulcers on neck and limbs and persisted for a long time. Secondary lesions, nodular ulcers suggesting a mulberry, develop in mucus of nose, pharynx, tonsils, pillars of fauces, soft palate, tongue, cheeks, gums, larynx, and sometimes even extend to the external surface of the head. The ulcers gradually extend, accompanied by great salivation, ending after 20-30 years in a cachectic state. The disease appears somewhat analogous to that in Brazil described by Splendore & Lutz.

Cells ovoid, rarely spherical, 1.9-8μ in diameter, with granules staining purple with Giemsa stain while protoplasm stains blue. Cells solitary or in pairs, reproducing by sprouting.

Organism grows well on Sabouraud media, glucose and sucrose solutions, milk, potato, carrot, *Arracacha esculenta, Ipomoea batatis* and *Oxalis tuberosa.*

Cryptococcus sp. Irons & Graham, Trans. Chicago Path. Soc. **6**: 445-448, 1906; Jour. Infect. Dis. **3**: 666-682, 1906.

Coccidioides immitis strain 2 Hamburger, Jour. Infect. Dis. **4**: 201-209, 1907.

The characters as given by Irons & Graham show a close similarity to the mycelium of *Zymonema capsulatum* and not to *Coccidioides.* Hamburger does not figure his strain.

PSEUDOSACCHAROMYCES

Pseudosaccharomyces van Laer, Bull. Ass. Belge Chimistes No. 3, 1893; Klöcker, Centralbl. Bakt. II, **35**: 375-388, 1912, not Šamberger, Sbornik Klinicky **5**: 466-485, *Pl. 6,* 1904, nor Briosi & Farneti, Atti Ist. Bot. R. Univ. Pavia II, **10**: 31, 1906.

Hansenia Zikes, Centralbl. Bakt. II, **30**: 145-149, 1911, not Zopf, Zeitschr. Naturw. **56**: 539, 1883, nor Lindner, Jahrb. Vers. Lehranstalt Brau. Berlin **7**: 448, 1904.

Kloeckeria Janke, Centralbl. Bakt. II, **69**: 310, 1923 (spelling corrected to *Kloeckera* by Janke, Centralbl. Bakt. II, **76**: 161, 1929).

I have been unable to locate a copy of van Laer's publication and hence I am not sure as to the synonymy of *Hansenia* Zikes and *Kloeckera* Janke. The type species of the two latter is *Saccharomyces apiculatus* Reess (asporogenous strains only). Šamberger uses *Pseudosaccharomyces* for any asporogenous yeast without reference to spore shape. His use became the type of *Parasaccharomyces* (see p. 265). Briosi & Farneti follow Šamberger in their definition but apply it to an organism of wholly different affinities. *Pseudosaccharomyces* must either be dropped as a permanent source of confusion or used in the original sense of van Laer. If the former is done, *Kloeckera* is the next valid name for the group. Klöcker (1912) restricted *Pseudosaccharomyces* to asporogenous yeasts with citriform cells and described 16 new species. Ciferri & Redaelli, Ann. Myc. **27**: 243, 1929, and Lodder, Anaskosporogenen Hefen **1**: 232, 1934, characterize *Kloeckera* as follows:

Cells usually apiculate or citriform, with occasional ellipsoid cells; not producing ascospores, single or only slightly clinging together, smooth, hyaline or bright colored; usually fermenting and producing acid in sugars; assimilating peptone only; no growth on alcohol; gelatin liquefied.

This genus is saprophytic, usually isolated from soils. No mammalian pathogens so far reported.

ATELOSACCHAROMYCES

Atelosaccharomyces Beurmann & Gougerot, Tribune Méd. **42**: 502, 1909.

The type species is *Atelosaccharomyces Busse-Buschki* (*Cryptococcus hominis*). To illustrate the morphology of the genus the authors figure the *Cryptococcus* of Gotti & Brazzola (*A. Gottii*) and *Cryptococcus guttulatus* (*Saccharomycopsis guttulatus*).

Cells always thick-walled in tissue, usually so on media in the adult stage; sediment usually slimy, pellicle rare; gelatin not liquefied, sugars fermented.

This genus was originally conceived as a name for all the asporogenous yeasts, in which sense it is synonymous with *Cryptococcus,* a much older name. By emending the description, however, to include only those forms which ferment sugars and do not liquefy gelatin, we have a very serviceable genus to cover a group of pathogens. Unless one is to disregard all the work of most of the older authors and develop a wholly new set of criteria of genera, this seems the best arrangement. Even so several species are of doubtful position because of brief descriptions. There is practically not a single character of strictly generic or specific rank which has been recorded for every species so far described in the imperfect yeasts. It is to be hoped that by calling attention to the older literature, that some of these species may be found again and described in sufficient detail to show their place in the classification.

Key to Species

Ferments glucose and fructose only.

Colony white on most media, becoming grayish brown on potato. *A. hominis.*

Colony white on most media, becoming yellowish on potato; almost no growth on blood serum. *A. Catanei.*

Colony yellowish white on Sabouraud agar, brownish in age on potato glycerol. *A. Conori.*

Colony white, becoming brownish on malt agar, grayish white and dry on potato, light yellow and moist on blood serum. *A. membranogenes.*

Ferments sucrose and maltose, milk coagulated.

Cells spherical, 4-8μ, colony on carrot white, smooth, humid. *A. laryngitidis.*

Cells ellipsoid, 7-10 × 5μ, colony on carrot white, finally becoming pale rose, granular pulverulent. *A. clericus.*

Ferments sucrose, maltose, and galactose.

Cells spherical, 6-9μ. *A. pyogenes.*

Atelosaccharomyces hominis (Vuillemin) Froilano de Mello, Paes & Sousa, Arq. Hig. Pat. Exot. **6**: 34, 1918.

Saccharomyces sp. Busse, Centralbl. Bakt. **16**: 175-180, *4 figs.,* 1894; Arch. Path. Anat. Physiol. **140**: 23-46, *Pls. 1-2,* 1895; *Ibid.* **144**: 360-372, 1896.

Cryptococcus hominis Vuillemin in Gedoelst, Champ. Paras. Homme 50-51, 1902.

Atelosaccharomyces Busse-Buschki Beurmann & Gougerot, Nouvelle Mycoses 29, 1909 (cf. Hudelo, Beurmann & Gougerot, 1911).

Torulopsis hominis Castellani & Jacono, Jour. Trop. Med. Hyg. **36**: 315, 1933.

Not *Saccharomyces hominis* Klein & Gordon (1904).

Isolated from subperiosteal suppuration of the tibia with purulent osteitis terminating in a generalized infection. Must be differentiated from syphilis or tuberculosis. Pathogenic to rabbits and mice.

Cells ovoid or spherical, thick-walled, elements united in a common homogeneous gelatinous sheath. Multiplication by sprouting. Neither mycelium, asci, nor spores seen. Optimum growing temperature 37° C.

Growth good on glycerol agar. On potato, colony is dirty white, later becoming grayish brown, viscous. On gelatin, colonies small, white, shining, rounded after 24 hours, later elevated. Colonies on coagulated serum dirty white, confluent in a thick layer. In broth, a thick whitish sediment appears. Prune decoction turns dirty white with thick sediment. Gelatin not liquefied.

Atelosaccharomyces Catanei Dodge, n. sp.

Cryptococcus sp. Catanei, Arch. Inst. Pasteur Algérie **3**: 384, 385, 1925.

Isolated from cases of black pilose tongue along with *Castellania linguae-pilosae.* Not pathogenic for guinea pig or rabbit.

Cells in liquid media small, 2-4.5μ in diameter, spherical or ovoid; on solid media, slightly larger, 4-5.3 × 2-2.6μ, budding but not more than 3 cells clinging together at one time. Rarely slightly longer cells appear on potato and Sabouraud conservation agar.

On Sabouraud glucose, colonies round, white, creamy, shining; on conservation agar, colonies very small and opaline. On gelatin, colonies small, white, growing along line of stab without arborescence; practically no growth on serum. On potato, colonies slightly yellowish, dull. On potato glycerol, colonies lighter and creamy; on carrot, colonies very small. On broth and peptone solution, no pellicle or ring, sediment light. Glucose and fructose fermented with acid production, no action on other sugars. No action on milk, serum, or gelatin.

Atelosaccharomyces Conori Dodge, n. sp.

Cryptococcus sp. Conor, Arch. Inst. Pasteur Tunis **1912**: 215-218, 1912. (Case history of Conor & Bruch, Bull. Soc. Path. Exot. **4**: 360-368, 1911.)

Isolated from ulcer with small nodules, giving a cheesy matter, at base of skull and neck. Ulcer failed to respond to treatment and infant died in about 6 months from onset. Organism produced lesions on liver, spleen, and lungs of experimental animals.

Cells spherical or ovoid, 4-10μ in diameter, no trace of hyphae, cells occurring singly or in pairs, very rarely in three's. No change of morphology on desiccation or aging of culture (up to one year). No ascospores found. Growth very slow at 15°-18°, optimum at 37° C.

Colonies on Sabouraud agar, yellowish white, creamy, slightly elevated, and regularly rounded. On Sabouraud with tartaric acid, 1:1,000, growth much more rapid with same appearance as the preceding. On potato, growth thick, whitish, mammillate, becoming pebbled on drying. On glycerol potato, growth moist, shining, with sediment on bottom of tube, brownish in age. On carrot, growth quite scanty, whitish. Peptone broth clear with slight sediment. In acid glucose broth, growth more rapid with floccose sediment. Glucose and fructose fermented. No action on maltose, lactose, or mannite.

Atelosaccharomyces membranogenes (Steinhaus) Dodge, n. comb.

Saccharomyces membranogenes Steinhaus, Centralbl. Bakt. I, **43**: 49-69, 1907.

Cryptococcus membranogenes Vuillemin, Champ. Parasit. Homme Anim. 94, 1931.

Found in diphtheric false membranes. Pathogenic for rabbit, guinea pig, and mouse, producing an acute inflammation with hemorrhagic exudate. Perhaps Strain II of Gentzsch (1908), isolated from diabetic urine drawn from the bladder under sterile conditions, should be referred here.

Cells spherical, the size of a red blood cell, multiplying by sprouting from any portion of the cell, no capsule in cultures.

On 3% malt agar, colonies circular, moist, white, soon confluent, finally becoming brownish. On potato, growth dry, gray white, circular, confluent. On Loeffler's blood serum, colony moist, circular, light yellow. On gelatin, colonies white, shining, granular, at times surface suggests fat. Only glucose fermented.

Atelosaccharomyces laryngitidis (Sartory, Petges & Claqué) Dodge, n. comb.

Cryptococcus laryngitidis Sartory, Petges & Claqué, C. R. Soc. Biol. **84**: 179, 180, 1923.

Monilia laryngitidis Vuillemin, Champ. Parasit. Homme Anim. 84, 1931.

Torulopsis laryngitidis Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Producing pharyngolaryngitis. Symptoms are a tickling sensation in throat, burning sensation in air passages, continual cough with abundant expectoration. Free edge of epiglottis and upper face of arytenoid cartilage had principal lesions which appeared as large, protruding, opaline plaques separated by narrow bands of healthy tissue. No lesions in larynx. No tuberculosis or syphilis. Lesions finally cured by medication with potassium iodide.

Cells 4-8μ in diameter; ascospores not seen. On carrot, optimum temperature for growth was 28°-32° C., growth ceases at 39°-40°, but colony lived for 15 days at least at this temperature. Pellicle on broth at 25°-28° and 32°, but not at 35°-37°.

On agar and gelatin plates, colonies round and white. On potato, colonies white, turning gray later. On carrot, colonies white, smooth, humid. On gelatin stab, growth in depths as well as at surface. Pellicle in broth. In sugar broths, growth is active, with the production of a uniform cloudiness. Glucose and maltose fermented, but not lactose or galactose. Sucrose is inverted. Milk coagulated on twelfth day but casein not peptonized. Gelatin not liquefied.

Atelosaccharomyces clericus Dodge, n. sp.

Cryptococcus sp. Clerc & Sartory, C. R. Soc. Biol. **64**: 135-137, 1908.

Isolated from a case of chronic angina with small yellowish concretions on pillars of fauces, tonsils, and posterior wall of pharynx. Pathogenic to guinea pig.

Cells ovoid, 7-10 × 5μ, isolated or in groups of five or six, sprouting at one pole. No mycelium or spores on any medium tried. Gram-positive. Optimum temperature 30° C.

Colony on agar white, on potato dirty white. On carrot, colony at first smooth and pure white, later becoming granular, pulverulent, and pale rose in color. Poor growth on serum. Alcoholic fermentation of sucrose and maltose but not galactose. No aldehyde formation. Sucrose inverted. Starch not digested. Gelatin not liquefied, milk coagulated but no digestion of curd.

Atelosaccharomyces pyogenes (Mattlet) Dodge, n. comb.

Cryptococcus pyogenes Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 13-14, 1926.

On potato decoction, at 37° C., appear yeast forms, spherical, rarely ovoid, 6-9μ in diameter, multiplying only by sprouting. No fat granules.

On Sabouraud agar, colonies circular, dull, slightly yellowish at the center and crumpling with fine radial striations, giving the margin a lacy appearance. On potato decoction, there is formed a coherent, membranous sediment which breaks up on shaking. Acid formation and very active fermentation with glucose, fructose, maltose, galactose, and sucrose. No action on gelatin or milk.

This organism is close to *Cryptococcus hominis* Vuillemin, but differs in its active fermentive power.

Perhaps the unnamed species of *Cryptococcus* described by Brazzola belongs here.

Cryptococcus sp. Brazzola, Mem. R. Accad. Sci. Bologna V, **6**: 303-310, *1 pl.*, 1897 (Sez. Med. Chirurg. 43-50).

Isolated from a case of gangrenous pharyngitis with infiltration of all the glands of the neck. Pathogenic to guinea pigs.

Cells of variable size and irregular groupings, walls thick.

On agar, glycerol agar, and gelatin, colonies round, margins slightly fimbriate, center thicker, yellowish white, becoming darker on aging. On potato, growth rapid, colony thick, mammillate, margin fimbriate, pearl white becoming dark yellowish, especially after exposure to rather intense light. On broth, a slight pellicle and no turbidity. On milk, growth luxurious without coagulation. Fermentation of glucose, maltose, and lactose. Optimum temperature between 30° and 35° C.

Doubtful Position

Atelosaccharomyces Gottii (Neveu-Lemaire) Froilano de Mello, Paes & Sousa, Arq. Hig. Pat. Exot. **6**: 34, 1918.

Cryptococcus sp. Gotti & Brazzola, Mem. R. Accad. Sci. Bologna V, **6**: 721-754, *2 pls.*, 1897 [Sez. Med. Chirurg. 257-290].

Atelosaccharomyces sp. Beurmann & Gougerot, Bull. Mém. Soc. Méd. Hôp. Paris III, **28**: 251, 1909.

Isolated from lesions in the nasal passages of a horse. Pathogenic for guinea pigs.

Cells from the lesion encapsulated, large, slightly ovoid or spherical, sprouting. In cultures capsule absent or slightly developed.

On glycerol agar, white to mother-of-pearl colonies, creamy to almost gelatinous, margins slightly fringed, browning in age. On potato, growth rather rapid, colony rather thick, creamy, at first white, then grayish and finally gray brown, or even tobacco brown if exposed to light. On gelatin, colonies mother-of-pearl white, margins fringed, becoming granular and irregular, yellowish gray but not brown. No growth on coagulated serum. Growth poor on liquid media, no turbidity and no pellicle, with a slight sediment at the bottom of the tube. Gelatin not liquefied.

The position of this species is uncertain since no fermentation is recorded, and it is quite likely it belongs in *Cryptococcus* or even in *Zymonema,* since it was not observed long enough to be sure that no hyphae were produced. Sprouting occurs only at the ends of the cells, and occasionally the cells cling together in short chains.

Cryptococcus niger (Mafucci & Sirleo) Gedoelst, Champ. Paras. Homme 59, 1902.

Saccharomyces niger Mafucci & Sirleo, Policlinico, Sez. Chirurg. **2**: 138-144, 245-254, 1895.

Torulopsis niger Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from pulmonary myxoma of a guinea pig.

Cells small, sprouting, dark.

Colonies on agar, circular, whitish, covering the whole surface. On potato, colonies grayish and chocolate color. In glucose broth, sediment but no pellicle. Good growth in milk. Alcoholic fermentation of malt extract. Gelatin not liquefied. Little growth on gelatin, less on blood serum, and very little on beef broth.

Quite probably this species should be transferred to the Toruleae.

Cryptococcus sp. Breed, Arch. Int. Med. **10**: 108-121, *Figs. 1-6,* 1912.

Isolated from the respiratory tract of man, also from one case of severe vaginitis. Pathogenic for rabbits, white rats, guinea pigs, and monkeys. Cure effected by medication with sodium iodide.

Cells size of a red blood corpuscle. No spores found. Grows between 18° and 69° C., though slight at room temperature. Killed in one hour at 71° C. Viable dry for 2 years.

In 12-24 hours at 37° on glucose and glycerol agars there is a profuse creamy growth. On potato slant under similar conditions, a slight film forms. Grows on plain or glucose broth with production of heavy sediment (and foam with latter), on shaking. Good growth on plum and grape decoctions but no foam. Growth on litmus milk creamy white with soft curd in 24 hours. Glucose fermented. Growth but no fermentation on lactose, raffinose, inulin, and mannite.

Cryptococcus de Burnier (cas Th) Ota, Ann. Parasitol. Hum. Comp. **2**: 44-45, *Fig. 5,* 1924.

Isolated from a case of epidermomycosis.

On malt agar, at 25° C. in day-old cultures, cells ovoid or slightly elongate, solitary or in chains of a few cells, 6-8 × 4-5μ, wall thin. After a week, cells 12 × 10μ, spherical or ellipsoid, wall thicker.

On malt agar, colony grayish white becoming yellowish, smooth, humid, margin definite. On malt extract, forming a thin ring and sediment.

TORULOPSIS

Torulopsis Berlese, Giorn. Viticoltura ed Enologia 54, 1894.

I have been unable to locate the original publication of this name, but it was designed to end the confusion caused by the application of *Torula* to two different groups of organisms (see p. 327). This has been applied to the asporogenous yeasts, following the traditional application of *Torula* by Turpin, Mém. Acad. Sci. 17: 1-88, 1838, Pasteur, Études sur la Biére 73, 1876, Hansen, Medd. Carlsberg Lab. 2: 87-93 [47-52], 1888, Will (1916), etc. Turpin probably included both asporogenous and sporogenous strains and emphasized fermentation; Pasteur held the same concept, but denied fermentation. Hansen was the first to use the name in the modern sense, applying it to asporogenous yeasts without regard to fermentative power.

In proposing this genus name, Berlese gave a good résumé of the characters given by Hansen, limiting its application definitely to the forms without mycelium, and excluding the species with citriform cells (see *Pseudosaccharomyces*). Will (1916, 1917) still further restricted the generic concept (although still using the name *Torula*), defining it as follows:

Young cells with refractive protoplasm, no oil globules, pellicle slimy, usually arising as separate floating islets which are confluent, glassy but tough, sediment more or less gelatinous. Ciferri & Redaelli (1929) still further modify it by excluding species with agglomerations of cells or pseudomycelium. Since so many of the species are pink or reddish, these authors have discarded Berlese's *Torulopsis rosea* as the type species in favor of *Torula gelatinosa* Will, since they claim that the adoption of such a poorly described species would be a permanent source of error.

They characterize their genus as follows: Cells ellipsoid, spherical, or irregular, never citriform or catenulate, rarely, and this particularly in liquid cultures, with formation of irregular sprouting agglomerates of crowns and elongated cells, cells continuous, hyaline or light colored, not forming endospores, mycelium or pseudomycelium. Cell wall thin, young cells without the oil globules which may appear in old age; superficial vegetation with giant colonies according to Will's Type III; little or no fermentative power, usually forming acids on sugar media; producing hydrogen sulphide and coagulating milk; producing a carotin pigment, hence colors some shade of orange or red.

Key to Species

Cells large, 8-12μ, spherical to elongate.	
Glycerol assimilated.	*T. cavicola.*
Glycerol not assimilated.	*T. bronchialis.*
Cells smaller, rarely over 8μ.	
No ring to liquid media.	
Gelatin liquefied, colony rose becoming the color of eosin powder.	*T. mena.*
Gelatin not liquefied.	
Milk coagulated, colony orange yellow.	*T. Sangiorgii.*
Milk not coagulated, colony reddish orange.	*T. mitis.*
Ring and often floating islets but no pellicle on liquid media.	
Gelatin liquefied.	
Nitrate assimilated.	*T. glutinis.*
Nitrate not assimilated.	
Cells long ellipsoid, often curved, milk not clotted.	*T. rubra.*
Cells spherical or short ellipsoid, milk clotted.	
Cells 4-5 × 5-7μ.	*T. Sanniei.*
Cells 2.5-4 × 4-6μ, more slender.	*T. mucilaginosa.*

Torulopsis cavicola (Artault) Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Cryptococcus cavicola Arthault, Arch. de Parasitol. **1**: 259-265, 1898.

(Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 740, 1901, suggests that this is close to or a strain of *Saccharomyces Fresenii* or *S. roseus.*)

Isolated from pseudotuberculosis in lung of guinea pig. Only slightly pathogenic to rabbit on subcutaneous injection. Inoculated into eye of rabbit, it produced lesion from which organism was reisolated.

Cells ovoid, 8-12μ, solitary or, rarely, in chains of three.

On agar, growth slow, suggesting *Serratia marcescens* (*Bacillus prodigiosus*). On potato, colony similar to that on Raulin's, but thicker, redder, and moister. On Raulin's liquid, colonies rose to clear vermilion, margin irregular, surface shining to oily, becoming 1 mm. thick and spreading over the whole surface of the medium. On 5% or 10% glucose solution no pellicle appears, very slight pigment, medium turbid, no fermentation (?). Organism attacks oil used to secure anaerobiosis, apparently assimilating glycerol and leaving floating masses of stearic acid crystals at interface of oil and medium.

Torulopsis bronchialis Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia, III, **2**: 245-248, 283, 1925.

Rhodotorula bronchialis Lodder, Anaskosporogenen Hefen **1**: 91-93, 1934.

Isolated from sputum of a patient with bronchopneumonia, not pathogenic for laboratory animals.

Cells ovoid, at first hyaline, then guttulate, 7-7.5μ in diameter up to 9-9.5 × 10μ, often forming short chains. On malt extract, 3-4 × 5-8μ, singly or in pairs. No spores or mycelium.

On carrot agar, colonies dense, creamy, radially folded, opaque, shining, ochraceous to reddish. On malt agar, colony intense orange, moist, smooth, margin pellucid. On gelatin, colonies red orange, verrucose radially folded. On carrot, colonies small, uniform, surface irregular, reddish. On potato, colonies spreading, flesh red, uniform, margins smooth, becoming irregularly granulose. On malt extract, a pulverulent pellicle formed by confluence of single colonies with granular sediment. On glucose broth, similar, pellicle pink. Methylene blue reduced slowly. On milk, pellicle almost white, casein precipitated after one month and very sowly digested. No alcoholic fermentation; acid with glucose, fructose, galactose, sucrose, lactose, and inulin. Lactose not assimilated (Lodder).

Torulopsis mena (Fontoynont & Boucher), Dodge, n. comb.

Cryptococcus mena Fontoynont (nom. nud.), Bull. Mém. Soc. Chirurg. Paris **48**: 439-442, 1922; Fontoynont & Boucher, Ann. Derm. Syphiligr. VI, **4**: 213-235, *3 figs.*, 1923; Ota, Ann. Parasitol. Hum. Comp. **2**: 45-47, 1924.

Isolated from ulcerations on great toe and legs, with severe lesions on chest due to earlier unsuccessful surgical interference when lesion was mistaken for cold tuberculous abscess. Medication with potassium iodide, etc., wholly unsuccessful; in fact, KI made lesions worse. Final cure effected by internal and external applications of methylene blue. Even in pure cultures, 0.0015-0.002% methylene blue checked growth. Organism secretes a toxin fatal to rat and guinea pig. No agglutination of *Cryptococcus* with patient's blood nor with other blood, but agglutinations prompt in presence of methylene blue.

Yeast cells ellipsoid, 4-5μ in diameter, sprouting on second to fourth day. By thirtieth day cells become more rounded, cell walls smooth. Optimum temperature 20° but growth good also at 37° C.

On glucose agar, colony rose, finally becoming brick red, attaining diameter of 2.5 cm. in 5 days. On maltose agar, colony rose brown. On poor agar, colony develops very slowly with production of bad odor. On potato, colony rose, terra cotta, then red brown. On glucose gelatin, colony rose by reflected light, grayish white beneath and by transmitted light, later becoming color of eosin powder. In glucose broth, liquid remains clear with sediment which is white at first, slowly turning rose. Gelatin slowly liquefied. Pigment production varies with temperature, being less at higher temperature, also less when organism is freshly isolated.

Var. **Mekundu** (Mattlet) Dodge, n. comb.

Cryptococcus Mekundu Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 14, 15, 1926.

Isolated from sputum in case of bronchitis in Belgian Congo. Patient had been weakened by malaria, bronchitis accompanied by a low continuous fever with periodic exacerbations suggesting undulant fever, but no agglutination with *Micrococcus melitensis.* Patient removed to Europe shortly after organism was isolated and not further studied.

In sputum, cells 3-4μ in diameter. On potato decoction at 25°, cells spherical or ovoid, walls thin homogeneous on third day, sprouting, 2-6μ in diameter. Older cells have thick walls.

On Sabouraud agar, colony red, circular, soon flowing to bottom of slant. On potato decoction, rose sediment on bottom and walls, clots disappearing on agitation. Gelatin liquefied, optimum temperature 25° C. Slight acid production in, and coagulation of, milk. Acid with glucose, fructose, galactose, sucrose, and lactose.

Close to *T. mena,* but interior of cells less granular.

Torulopsis Sangiorgii Dodge, n. sp.

Cryptococcus sp. Sangiorgi, Centralbl. Bakt. I, **63**: 58-62, 1912.

Isolated from the peripheral blood stream and from the liver of a dog after 5 months of fever. Pathogenic for dog, slightly for rabbit.

Cells in liquid media ovoid or ellipsoid, on solid media similar or very rarely spherical. Extreme dimensions 4-6 × 3-5μ. Sprouting from the ends of cells on solid media producing chains of 2-4 cells but no true hyphae. Growth at 20° and 27° C., the higher temperature best for acid media.

On Sabouraud agar, colony rosy, moist, creamy. On lactose agar, colony very superficial. Growth slight on plain agar, blood agar, and coagulated horse serum. On potato, colony thick, spreading, creamy, moist below, and powdery above. Colonies orange yellow on most media but grayish white on blood agar. On gelatin, growth slow, penetrating the medium. In plain broth, liquid remains clears, no pellicle, and slight sediment. In glycerol broth, sediment on bottom and walls but no pellicle. No indol formation in peptone solution. No fermentation of glucose, maltose, lactose, dextrin, or inulin, no inversion of sucrose. Milk coagulated in 27-30 days. Gelatin not liquefied in 90 days.

Torulopsis mitis (Mazza, Stabile de Nucci & Canal Feijóo) Dodge, n. comb.

Cryptococcus mitis Mazza, Stabile de Nucci & Canal Feijóo, Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires **5**: 293-308, *21 figs.,* 1930.

Producing pustules, originally appearing on the face, subsequently spreading to all external parts of the body, in a 10-year-old Argentine boy. Lesions secreting a serous, sanguinolent liquid. Medication with increasing doses of potassium iodide caused eventual complete cicatrization of the lesions. Emulsion of yeast isolated and reinjected into dermis of patient caused local reaction. Emulsions of organism cultivated on Sabouraud agar injected intraperitoneally into Cebus monkey, rabbit, guinea pig, two mice and two rats, nonpathogenic. Scarifications and rubbing with organism caused no lesions on monkey. Subcutaneous injection into white rat caused appearance of nodule which, removed and examined, showed presence of organism.

On Sabouraud agar, cells round, averaging 5μ in diameter, possessing a thick membrane with an unevenly granular content. No hyphae or asci seen after long observation. Reproduction by sprouting. Gram-positive.

On Sabouraud agar, at 37° C., no growth. At room temperature after 3 days, orange red colonies, slightly elevated at center, scalloped margin. After 10 days colonies elevated, margin undulate, with a few radial furrows. Organism grows well on potato or carrot and glycerol, also on plain agar and Gougerot gelatin and always at room temperature. In plain broth, slight cloudiness in 48 hours. In Sabouraud broth, general turbidity. Fermentation after 48 hours with raffinose and fructose, none with sucrose, inulin, lactose, mannite, maltose, galactose, sorbite, glucose, dextrin, or arabinose. No indol formation. Milk not coagulated.

Torulopsis glutinis (Fresenius ampl. Harrison) Dodge, n. comb.

Cryptococcus glutinis Fresenius, Beitr. Mykol. **2**: 77-78, 1852.

Saccharomyces glutinis Cohn, Beitr. Biol. Pflanzen **1**: 187, 1875 (cf. Hansen, Medd. Carlsberg Lab. **1**: 253-264 [81-88]1879, etc.).

Torula glutinis Pringsheim & Bilewsky, Beitr. Biol. Pflanzen **10**: 118, 1910.

Rhodotorula glutinis Harrison, Trans. R. Soc. Canada **22**: 187, 1928 [cf. Lodder, Anaskosporogenen Hefen **1**: 65-68, 1934].

The following pink yeasts rather imperfectly described are often referred here but may belong to other species of this genus.

Saccharomyces roseus Engel, Bull. Soc. Sci. Nancy **6**: 1, 1877 (cf. Maggiora & Gradenigo, 1896).

Saccharomyces rosaceus Crookshank, Introd. Pract. Bact. 224, 1886 [cf. Vuillemin & Legrain, Arch. de Parasitol. **3**: 260-266, 1900].

Saccharomyces Fresenii Schroeter, Kryptog. Fl. Schlesien **3**: 2: 208, 1893.

This species seems to be primarily a saprophyte, not pathogenic for laboratory animals, although from time to time reported as isolated from otitis media, etc., perhaps as a contaminant, as this group of pink yeasts is frequently found in old laboratory cultures. The following description is based on culture of Pringsheim & Bilewsky isolated from air, amplified by Harrison and Lodder who studied the same strain.

Cells ellipsoid, 3-4.5 × 5-7μ, mostly single or in pairs, rarely in small chains.

On malt agar, colony red with orange tone, moist, smooth, slimy. On malt gelatin, colony shining, rose, punctate, margin dentate. On malt extract, slimy islets, a broad ring, with thick slimy sediment, liquid turbid, rose color. No fermentation; acid with glucose, fructose, and mannose; potassium nitrate assimilated; gelatin liquefied.

Torulopsis rubra (Demne) Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Saccharomyces ruber Demne, Ann. Micrcgr. **2**: 555, 556, 1889 [1890]; Mitt. Naturf. Ges. Bern **1889**: ix-xi, 1890; Festschr. E. Kenoch Berlin, 1890; Casagrandi, Ann. Ig. Sperim. **8**: 535-545, 1897-1898.

Cryptococcus ruber Vuillemin, Bull. Séances Soc. Sci. Nancy III, **1**: 61, 1900.

Rhodotorula rubra Lodder, Anaskosporogenen Hefen **1**: 69, 1934.

Originally isolated from a red cheese and later from feces of children with diarrhea who drank some of the milk from which the cheese was made. Thought by Demne not to be pathogenic, although when pure cultures were fed to dogs in large doses, digestive disturbances resulted. Casagrandi isolated the organism from diabetic urine which had been exposed to the air. Recently Bagnacci (1926) reports this species in glossitis of an infant. Pathogenic in subcutaneous injections to guinea pigs and rabbits, also by ingestion of milk cultures which produce diarrhea.

Cells 3.8-4.5-6.8μ in diameter, in short chains of 3-4 cells. Chlamydospores 7.5-8.5 × 5-5.5μ.

Grows on glucose agar, better on glycerol agar, producing pale rose colonies which become reddish chestnut in color and are elevated, shining, with margin lobed. On Pollacci agar, colony at first whitish becoming red, plane or with center elevated, moist, shining, with margin lobed. On malt agar, colony orange, moist, smooth, margin pellucid. Growth on potato even better, colony red, 2-3 mm. thick. No growth in agar with more than 5% tartaric acid. On gelatin, colonies yellowish at first becoming clear raspberry red, nailhead size, with whitish lobed margin. In glucose broth, there is a whitish pellicle, reddish sediment, and no turbidity. Casagrandi reports fermentation of glucose and sucrose, others report no fermentation. Sucrose inverted. Milk not acidified or coagulated. Gelatin liquefied in 2-4-10 months.

Torulopsis Sanniei Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, **2**: 245-248, 283, 1925.

Rhodotorula Sannei Lodder, Anaskosporogenen Hefen **1**: 99-101, 1934.

Isolated from lungs. Not pathogenic for laboratory animals.

Cells ovoid or ellipsoid, often spherical, single, at first hyaline then guttulate, 4-5 × 6-7.5μ, no ascospores or mycelium.

On carrot agar, colonies peach blossom red, margins somewhat serrate, then the surface wrinkled and brick red. On must gelatin, colonies round with fine concentric furrows, blood red. On malt gelatin, colonies moist, almost smooth, slightly punctate in the middle, margin smooth. On malt extract agar, colonies red to slightly orange, shining, with small warts and sinuous margin. On malt extract, ring thin, thick sediment. No fermentation of sugars. Milk coagulated, gelatin liquefied (denied by Lodder).

Torulopsis mucilaginosa (Jörgensen) Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, **2**: 147, 1925.

Torula mucilaginosa Jörgensen, Die Mikroorg. d. Gärungsindustrie ed. 5, 402, 1909.

Rhodotorula mucilaginosa Harrison, Trans. R. Soc. Canada **22**: 187, 1928.

Cryptococcus rubrorugosus Castellani, Arch. Derm. Syphilol. **16**: 403, 1927.

Rhodotorula mucilaginosa race *rubrorugosa* Lodder, Anaskosporogenen Hefen **1**: 104-105, 1934.

Originally isolated as a laboratory contaminant. Castellani reports it from scrapings in the axilla.

Cells 2.5-3.8 × 3.2-5μ, single or in pairs.

On malt agar, colony intense red, dull, smooth with small warts in the center, margin smooth. On malt gelatin, colony red, center elevated with radial ridges, margin smooth. In malt extract, a broad ring and thick, slimy sediment. Good growth in alcohol. No fermentation; gelatin not liquefied.

Var. **pararosea** (Lodder) Dodge, n. comb.

Cryptococcus pararoseus Castellani, Arch. Derm. Syphilol. **16**: 402, 1927; Amer. Jour. Trop. Med. **8**: 393, 1928.

Rhodotorula mucilaginosa var. *pararosea* Lodder, Anaskosporogenen Hefen **1**: 102-104, 1934.

Isolated from sputum in a case of chronic bronchitis.

Cells ovoid to long ellipsoid, 2.5-4 × 5-9μ, single or in pairs in malt extract; a little shorter, 2.5-3.5 × 4-7.5μ, in malt agar.

Colony orange red, moist, elevated in the middle with radial folds, margin pellucid, ragged, somewhat slimy. On malt gelatin, colony red, with central knob, radial furrows, and sinuous margin. In malt extract, a ring and sediment produced. No fermentation, acid only with glucose and fructose. Growth good in alcohol. Gelatin not liquefied.

Var. **plicata** (Lodder) Dodge, n. comb.

Rhodotorula mucilaginosa var. *plicata* Lodder, Anaskosporogenen Hefen **1**: 108-110, 1934.

Cryptococcus corallinus A. Sartory, R. Sartory, Hufschmitt & J. Meyer, C. R. Soc. Biol. **104**: 1316-1318, 1930.

Torulopsis corallina Ciferri & Redaelli, Arch. Protistenk. **71**: 430, 1930 not *T. corallina* (Saito) Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III, **2**: 147, 1925.

Isolated from hair in pruriginous nodular lesions suggestive of trichophytic kerions.

In malt extract, cells short, ovoid, 2-3 × 4.5-6.5μ, solitary or in groups of 1-3 cells. On malt agar, cells 2-4.5 × 4-5.5μ. On Sabouraud agar, 1.5-2.5μ.

On Sabouraud agar, colonies cream white, viscous, moist, furrowed in drying (37° C.). At 27° C., colonies pink, finally salmon or coral red, much wrinkled, almost cerebriform. On malt agar at 15° C., colonies deep red to slightly orange, shining, wrinkled, margin sinuous, pellucid. On malt gelatin at 15° C., colonies smooth, moist, slightly elevated in the center, margin smooth, dirty yellow. On Raulin solution, slight cloudiness and rose-colored pellicle at 27° C. On malt extract at 25° C., ring and sediment. Glucose and maltose fermented (denied by Lodder), no action on lactose, fructose, galactose, and inulin. Lodder claims that fructose is assimilated, both Ciferri and Lodder that galactose is slightly assimilated. Milk coagulated on third to fourth day, pellicle rose color, not digested. Egg albumen not liquefied, serum not coagulated, gelatin liquefied.

Var. **Carbonei** (Lodder) Dodge, n. comb.

Saccharomyces glutinis Carbone, herb. nom. not Cohn, 1875.

Blastodendrion Carbonei Ciferri & Redaelli, Atti Ist. Bot. R. Univ. Pavia III **2**: 147, 1925.

Torulopsis nitritophila Ashford & Ciferri, Zentralbl. Bakt. II, **81**: 63-67, 1930.

Cryptococcus radiatus Sartory, Sartory & Meyer, C. R. Soc. Biol. **106**: 597, 598, 1931.

Probably first isolated as a contaminant, reported by Ashford & Ciferri from human feces and by A. Sartory, R. Sartory & J. Meyer as a saprophyte isolated during the study of an epidemic in which the disease was characterized by falling hair.

Cells spherical to short ovoid, 3.5-4.5 × 3.5-6μ, single or in pairs, slightly narrower on malt agar. On must gelatin, giant cells 6-10μ in diameter, cells aggregated in mucilaginous masses.

Colonies shining, bright salmon color, not folded. On Sabouraud agar, colonies English red, confluent, margin scalloped, with projections suggesting the pseudopodia of Radiolaria. On malt agar, colonies flame scarlet to orange chrome, moist, slimy, smooth, margin smooth. On malt gelatin, pale red, humid, flat, punctate, margin sinuous. On malt extract, a thin ring and a thick, slimy light salmon orange, sediment. No fermentation; no liquefaction of gelatin. Growth extremely good in neutral Raulin's solution with potassium nitrite (whence the name of Ashford & Ciferri's strain from human feces).

EUTORULA

Eutorula Will, Centralbl. Bakt. II, **46**: 226-281, 1916, non *Eutorula* Saccardo as subgenus.

Eutorulopsis Ciferri, Atti Ist. Bot. R. Univ. Pavia II, **2**: 141-143, 1925.

The type species is *Eutorula vulgaris* Will.

This renaming by Ciferri was unnecessary. He defines the genus as follows: Cells ellipsoid, spherical, or irregular, not apiculate nor catenulate, thin-walled, continuous, hyaline or light colored; no mycelium or pseudomycelium; no endospores, young cells uni- or pluriguttulate; pellicle dry, chalky white, often folded at first, becoming smooth, citron yellow to brownish yellow, clinging to the walls, ductile, or breaking, and portions floating on the surface. Sediment loose, often powdery. Gelatin liquefied, sugars fermented.

Key to Species

Ring, but no pellicle on glucose broth, colonies on potato glycerol dry, white, beginning to yellow about twenty-fifth day.	*E. fusca.*
Neither ring nor pellicle on glucose broth.	
Colony white or grayish, sediment white.	*E. Bernasconi.*
Colony ochraceous, sediment yellowish.	*E. irritans.*

Eutorula fusca (Fontoynont & Boucher) Dodge, n. comb.

Cryptococcus fuscus Fontoynont & Boucher, Ann. Derm. Syphiligr. VI, **4**: 325-330, *Fig. 6,* 1923; Fontoynont (nomen nudum), Bull. Mém. Soc. Chirurg. Paris **48**: 439-442, 1922.

Torulopsis fusca Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from ecthyma of the leg and mycetoma of the foot, with black grains (according to testimony of patient, but grains not seen by the authors). Pathogenic to rat, rabbit, and pigeon.

Yeast cells ovoid, 6-7μ in diameter, thin-walled.

On maltose or glucose agar, colonies white, becoming café-au-lait in color on eighth day and, finally, caramel colored. Elevated as in other slants. On ''poor'' agar, colonies small, not elevated, beginning to brown on the fifteenth day. Colonies on potato with glycerol, white and dry, 3 mm. thick, beginning to yellow on the twenty-fifth day. On sweet potato, colonies thick, creamy, colorless, shining, turning café-au-lait by the eighth day. Gas bubbles appear on thirteenth day. Growth begins to yellow on twenty-fifth day and by the third month turns a caramel color. On gelatin with glucose, colonies thick, white, creamy. Slow liquefaction after twenty-fifth day with liquefaction complete on the fifty-seventh day with a brown sediment. On glucose gelatin slant, colony hemispheric with a thin edge, turning caramel after a time. Glucose broth becomes turbid with large white sediment, ring but no pellicle. Liquid clears by the fiftieth day, with ring and deposit turning café-au-lait in color. Optimum temperature for growth 20°-22° C., growth very slow at 37° C.

Eutorula Bernasconi (Fontoynont & Boucher) Dodge, n. comb.

Cryptococcus Bernasconi Fontoynont & Boucher, Ann. Derm. Syphiligr. VI, **4**: 318-325, *Figs. 4-5,* 1923; Fontoynont, Bull. Mém. Soc. Chirurg. Paris **48**: 439-442, 1922 (nomen nudum).

Torulopsis Bernasconi Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Cause of extensive ulceration of the skin, with multiple suppurating adenitis. Slightly pathogenic for rabbit. In pigeon secretes a soluble toxin which is fatal.

Yeast cells ovoid or pyriform the first day, mostly 4-5μ in diameter but some as high as 7μ, few sprouting forms. On second day, cells all pyriform. No ascospores observed.

On glucose agar, colonies white, creamy. On maltose agar, the same, but with tendency to become thicker in the middle. Colony grayish on poor agar. On potato, colony dry and chalky white. In broth to which glucose has been added, white sediment, liquid clear, no pellicle or ring, some gas evolved. Gelatin is very slowly liquefied. This organism grows as well at 37° as at 20°-22° C.

Eutorula irritans (Mattlet) Dodge, n. comb.

Cryptococcus irritans Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 15, 1926.

Isolated from sputum of a patient in Belgian Congo, who had long attacks of coughing and dry râles. Greenish yellow purulent clots showing yeast cells were abundant in the sputum. Treated with potassium iodide and novarsenobenzol Billon. After 3 weeks, the symptoms and the yeasts disappeared from the sputum.

Yeast cells in sputum 2-4μ in diameter. On potato decoction at 25° C., in 3 days, yeast cells 2-6μ, thin-walled. Old cells thick-walled with fine radial striations.

On Sabouraud agar, colonies ochraceous, circular, soon flowing. On potato decoction, deposit of yellowish flocci, disappearing on shaking, no pellicle. On gelatin, liquefaction of upper portion in shape of a cone. Optimum temperature 25° C. No action on milk. Organism ferments glucose, fructose, maltose, galactose, and lactose, not sucrose, mannite, dextrin, or inulin.

ASPOROMYCES

Asporomyces Chaborski, Recherches sur les Levures Theromphiles et Cryophiles, Thèse Genève **627**: 26-30, 1918.

The type species is *Asporomyces asporus* Chaborski.

Reproduce only by sprouting, the yeast cells put forth copulation canals from time to time but no fusion occurs and no spores are produced.

Asporomyces Mugera (Mattlet) Dodge, n. comb.

Cryptococcus Mugera Mattlet, Ann. Soc. Beldge Méd. Trop. **6**: 12-13, 1926.

Frequently isolated from stools of dysentery patients in Belgian Congo.

In potato decoction, small spherical yeast cells with a small oil globule, about 3μ in diameter in 3 days, very old cells up to 7μ, spherical with the wall thick and somewhat warted. Copulation forms observed between cells about 4μ in diameter, but no ascospores seen.

On Sabouraud agar, colonies white, dull, circular, smooth, center of colony slightly yellowish in age. In potato decoction, slight turbidity with granular sediment, pellicle and ring formed. Optimum temperature 37° C. Milk, acid then neutral. Gelatin not liquefied. Acid formation in glucose, fructose, galactose, and sucrose.

MICROBLASTOSPORION

Microblastosporion Ciferri, Arch. Protistenk. **71**: 420-424, 1930.

The type species is *Torula botryoidea* Chaborski.

Sprout cells separate early from parent cell by wall, no polarity, no mycelium.

Grown only on media used to secure spore production. Colony radially striate, lobed. In liquid media, no pellicle, slight ring and sediment, gelatin liquefied.

TRIGONOPSIS

Trigonopsis Schachner, Zeits. f. d. ges. Brauwesen **52**: 137, 1929.

The type species is *Trigonopsis variabilis* Schachner.

Cells partly ellipsoid, partly appearing triangular, occasionally suggesting a crescent with rounded ends. Islets, a thin ring and sediment in liquid cultures; no fermentation, no liquefaction of gelatin.

Excluded Genera

Schizotorulopsis Ciferri, Arch. Protistenk. **71**: 431-435, 1930.

The type, *Schizotorulopsis Alfonsecai* Ciferri, Arch. Protistenk. **71**: 431-435, 1930, was shown by Verkaik (1931) to be a culture of *Bacillus megatherium* Bary.

As the following species have been so poorly described or even proposed as nomina nuda, they should be dropped until more adequate descriptions are available.

Cryptococcus albus Hlava cited by Vuillemin, Rev. Gén. Sci. Pures Appl. **12**: 741, 1901.

Cryptococcus epidermidis Castellani & Chalmers, Man. Trop. Med. ed. 3, 1075, 1919.

Torulopsis epidermidis Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Cryptococcus Lowi Castellani, cited by Sartory, Champ. Paras. Homme Anim. 243, 921. Tropical blastomycosis.

Cryptococcus Tonkini Castellani & Chalmers, Man. Trop. Med. ed. 2, 771, 1913.

Blastomyces Tonkini Legendre, Bull. Soc. Path. Exot. **4**: 24-26, 1911.

Torulopsis Tonkini Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

Isolated from two cases of blastomycosis in Tonkin. In pus, cells in short chains of 4-5 cells.

CHAPTER XIV

MALASSEZIA

Malassezia Baillon, Traité de Bot. Méd. Cryptog. 243, 1889.

Pityrosporum Sabouraud 1895; Castellani & Chalmers, Man. Trop. Med. ed. 2, 836-837, 1913.

The type species is *Microsporon furfur* Robin.

The members of this genus are obligate parasites confined to the outer layers of the epidermis and the sebaceous glands, not easily isolated and very easily dying out after the first transplant. In the scales, small yeast cells and occasional mycelium are shown. Colony dry and chalky.

The organisms of this group have been too infrequently cultivated and too poorly described to be placed definitely, but their very different cultural requirements and their very specialized habitat suggest that they belong to a different genus. One can only speculate whether they represent a very degenerate and highly specialized dermatophyte related to *Achorion* or whether they are related to yeasts. Their habitat on the host, suggests the former alternative, especially as the organism starts in the horny layer of the epidermis, and invades the hair follicle without attacking the hair shaft. The yeasts on the whole show much less narrow specialization to a habitat, being rarely localized on the outer layers of the skin, and when in this situation produce much more acute lesions.

Malassezia furfur (Robin) Baillon, Traité Bot. Méd. Cryptog. 243, 1889.

Microsporon furfur Robin, Hist. Nat. Vég. Parasit. 436-439, 1853.

Epidermophyton sp. Bazin, Leçons . . . sur les Affections Parasites de la Peau, 1862.

Sporotrichum (*Microsporon*) *furfur* Saccardo, Syll. Fung. **4**: 100, 1886.

Oidium (*Microsporon*) *furfur* Zopf, Die Pilze, 257, 1890.

Oidium subtile Kotliar, Vratche No. **12**: 2055, 1892 [in Russian].

Monilia furfur Vuillemin, Champ. Parasit. Homme Anim. 89, 1931.

This is the organism of pityriasis versicolor, isolated and described from the scales. Cultures reported by Schmitter, Jour. Trop. Med. Hyg. **26**: 190-194, 1923, and by Macleod & Dowling, British Jour. Derm. Syphilis **40**: 139-148, 1928. From his description, Kotliar probably had an *Actinomyces* species.

Hyphae 2-3μ in diameter. Spores 3-8μ in diameter, spherical or ovoid, very refractive, often budding, striated with spiral striae formed by budding, often in clusters, not easily stained. Method of staining: fix scales in absolute alcohol, stain with light green, eosin, or even zinc chloriodide.

On glycerol agar, there is a free, glistening, yellowish growth along streak. After a week, tiny white drops appear on the surface. These enlarge to 2 mm. in diameter and appear crateriform. Broth clouds with heavy sediment settling, indol produced. Acid is formed in lactose broth. Litmus milk clotted in 2 days, decolorized and peptonized in 10-20 days. Gelatin liquefied.

The organism cultivated and studied by Kambayashi (1932) is described as follows:

Spores mostly ovoid or elongate ovoid, 5-6 × 4μ, occasionally nearly spherical in liquid media. Hyphae short, either pointed or rounded ends, 2.4-2.6μ in diameter, straight or partially curved. In much older cultures, hyphae longer, richly branched, abjointing the ends of short lateral branches on a slightly differentiated conidiophore. Conidia sometimes in short chains of 2-3 cells, 3-5-6 × 4μ.

On Sabouraud, growth of primary culture very slow, about 9 months to produce a colony the size of a rice grain, whitish yellow, slightly verrucose. The first subculture attains about this size in 20 days. Colonies yellowish white, confluent, surface grooved and knotted, with a tendency for superficial grooves to be radial at the margins. The yellow of the young colony becomes lighter to grayish, then with age the yellowish color reappears and passes on to brown. Colony at first moist, becoming dryer and more chalky. The giant colony is a conical mass, about 3.5 cm. in diameter, with fine irregular radial folds cut irregularly by cross or circular folds, mostly moist, somewhat shining, margin whitish gray, central mass 1.5 cm. high.

A study of the authors' figures seems to show a conidiophore suggesting an *Acremonium* or, in some cases, even a suggestion of *Verticillium* or *Cladobotryum.*

The fact of the very long time of incubation and the fact that the colonies occurred near the edge of the plate suggest that the fungus described may be a contaminant. This work needs further confirmation.

Malassezia ovalis (Bizzozero) Acton & Panja, Indian Med. Gas. **62**: 603-614, *10 pls.*, 1927.

Pityrosporum Malassez, Arch. Physiol. II, **1**: 203-212, *Pl. 11;* 451-464, *Pl. 20,* 1874.

Saccharomyces ovalis Bizzozero, Arch. Path. Anat. Physiol. [Virchow] **98**: 441-459, *Pl. 13,* 1884.

Saccharomyces sphericus Bizzozero, Arch. Path. Anat. Physiol. [Virchow] **98**: 441-459, *Pl. 13,* 1884.

Saccharomyces capillitii Oudemans & Peckelharing, Nederl. Kruidk. Arch. II, **4**: 502-562, 1885. [Contr. Fl. Pays Bas **11.**]

Microsporum Malassezi Baillon. Bot. Méd. Cryptog, 1889.

Flaschenbacillus Unna, Monatsh. Derm. **13**: 225, 1891.

Microsporum Audouini Vuillemin, Bull. Soc. Myc. France **11**: 94-103, 1895 non aliorum.

Pityrosporum Malassezi Sabouraud, 1895.

Pityrosporum ovale Castellani & Chalmers, Man. Trop. Med. ed. 2, 836-837, 1913.

Cryptococcus ovalis Vuillemin.

Cryptococcus capillitii Vuillemin.

Cryptococcus Malassezii Benedek, Centralbl. Bakt. I, **116**: 47-67, 1930.

Torulopsis ovalis Almeida, Annaes Fac. Med. São Paulo **9**: 10, 1933.

? Pityrosporum Cantliei Castellani & Chalmers, Man. Trop. Med. ed. 2, 837, 1913.

Saccharomyces Cantliei Castellani, 1908.

Originally described by Malassez from the superficial horny layer and the mouths of the hair follicle in pityriasis sicca of the scalp, afterward reported from seborrhea capillitii. First named by Bizzozero, who also reported it from the heads of normal persons along with his *Saccharomyces sphericus.* Later it was confused with spores of various dermatophytes seen in scrapings [for careful review of this literature see Kraus 1913]. Unna (1891) claimed that the structures reported by earlier workers were swollen remains of a bacillus, which he referred to as the *Flaschenbacillus,* and which he described as follows: cells short cylindric, 1 × 2μ, either swelling to spherical cells, 2-3 times normal, or becoming flask-shaped, rarely pyriform or the shape of a dumb-bell, or even elongating to 2-3 times normal length, 1.5-3 × 2-4μ. Hoorn recognized *P. sphaericum* as a slowly growing white yeast similar to Pekelharing's *Saccharomyces capillitii* and *S. ovale* as a large flask-shaped bacillus with swollen forms. He also regularly isolated a small bacillus from seborrhea. Lomery returned to the hypothesis that it was a yeast and not a bacillus, and Tièche found these organisms in only 2 out of 50 cases of seborrhea.

Hodara apparently first succeeded in cultivating the organism but, as has been the experience of most subsequent workers, it died on attempted subculture. Acton and Panja are apparently the next ones who were successful with this organism. The following accounts of the organism, as well as of pityriasis and seborrhea, are largely taken from their paper.

Both the terms "pityriasis" and "seborrhea" have been used in different senses. In the original use, pityriasis was applied by Willans to the delicate pellucid scaling of the epidermis, without obvious signs of inflammation, of which dandruff is the most characteristic. This term has been variously extended by later authors to include scaling of wholly different origin, such as pityriasis rosea, etc. Seborrhea was originally used to designate an excessive flow of sebum, considered to be due to any functional disturbance of the sebaceous glands, without thought of disease. Hebra introduced confusion by teaching that the scales of pityriasis were dried flakes of sebum. When the flow is excessive, the flakes are oily, when normal, the flakes are dry. Since there are no sebaceous glands on the palmar and plantar surfaces, although they are often oily, Unna concluded that the oil was produced in the sweat glands. The French school, under the leadership of Sabouraud, advocated the theory that seborrhea was a mild local inflammation of microbic origin. Sabouraud recognized the yeast of Malassez and a gray coccus (*morococcus*), which Acton and Panja have since shown to be different stages of the same organism. Sabouraud also recognized the acne bacillus as a complication in many lesions producing acne (comedones or blackheads). Sabouraud (1932) recognizes pityriasis simplex capitis (dandruff), pityriasis steatoid (seborrheic eczema of Unna) usually a later stage of dandruff, which eventually leads to seborrheic alopecia (baldness), acne vulgaris (comedones or blackheads), papular seborrheas, in connection with acne rosacea and, finally, seborrheic warts of old age. Acton and Panja, using a dry, fatty medium, show that all conditions are due to the same organism, although secondary infections may occur. Two other kinds of scaling are common, pityriasis versicolor caused by *Malassezia furfur,* and pityriasis flava (tinea flava of Castellani) caused by *Malassezia tropica.*

Probably pityriasis capitis is the most important, as the scalp forms a continual source of scales for the transfer to other portions of the body, and until baldness begins to appear in middle life, it is easily overlooked and seldom treated by a physician. Also these scales usually contain *Staphylococcus albus* or *S. aureus,* thus forming a reservoir for these organisms to spread to other parts of the body, producing pimples, boils, etc.

When *Malassezia* grows on delicate skin, as that of the face, flexure of joints, etc., of children, the desquamation leaves the basal cell layer exposed, allowing the invasion of the corium by streptococci with the production of seborrheic eczema and eczema rubrum of children.

The synonymy may be tabulated as follows:

General terms: seborrheic dermatitis, seborrhagia, steatidrosis, seborrhea of Hebra, hyperidrosis oleosa of Unna, flux sebacea of Rayer.

Scalp lesions: dandruff, pityriasis capitis, seborrheic dermatitis of the scalp, seborrhea-sicca, seborrhea oleosa, seborrheic alopecia.

Glabrous skin: seborrheic dermatitis, pityriasis circinata, pityriasis steatoides, flannel rash, seborrhea corporis, lichen circinatus.

Acne: comedo, blackhead, grouped comedo, acne vulgaris, acne disseminata, acne necrotica.

Lips: exfoliative cheilitis.

With streptococcus as secondary invader: seborrheic eczema and eczema rubra.

For the benefit of the botanist who is unfamiliar with the structure and development of the sebaceous glands, I give the following summary from the work of Acton and Panja (1927) and of Sabouraud (1932). The embryonic skin consists of two layers: a basal layer of columnar cells and Rauber's layer, consisting of swollen cells which stain badly, and form a fatty substance which waterproofs the fetus against the maceration of the skin by the liquor amnii. About the fingers and toes, these cells are swollen, hemispheric, polyhedral, and are called "the bladder cells of Zander." After birth, the superficial layer begins keratinization. In the early stages of keratinization (first three years), *Malassezia* usually infects the scalp. The sebaceous glands, which are scattered over the surface of the body in fishes and amphibia, become associated with the hair follicles in the mammals. Some of the glands which are not associated with the follicles have taken on specialized functions. Of those associated with the hair follicle, those in the scalp, beard, etc., are simple or bilobed and relatively small, and are the sites of pityriasis, while those associated with the area of lanugo hair are larger, multilobed, often racemose and are found in the areas which furnish the sites of acne. Those associated with hair follicles seem to function in oiling the hair shafts.

Some of those not associated with hair follicles, are associated with the sexual glands. Of these the mammary glands are the most conspicuous, but smaller ones are found in the axilla, scrotum, prepuce, and labia which not only lubricate these regions but also produce volatile fatty oils which impart a distinct odor to the individual or to the species, the odor being especially marked during the mating season. These glands may be infected with various organisms which give rise to inflammation and abscess formation. Later in life, retention cysts may form in them as a result of previous irritation. Other sebaceous glands are concerned with the lubrication of the various orifices of the body, e.g., the ceruminous gland of the ear, the meibomian glands of the eyelids, the glands on the lips, those of the anal margin, etc. These glands are often the seat of staphylococcal inflammation, the organisms being derived from the scales in the scalp, resulting in abscesses of the external auditory meatus, styes, retention cysts, etc. In the palmar and plantar surfaces, their function is assumed by the sweat glands which produce small oil drops at the extreme ends of the coiled glands.

Sebum is an oily secretion, becoming cheesy on exposure to air. In chemical nature, it is similar to lanolin (sheep's wool fat). Besides the fatty acids, such as stearic and palmitic, there are volatile acids which impart the characteristic odor. Sebum is not a true secretion like milk of the mammary glands, but it is produced by the failure of the superficial layer of cells to undergo keratinization. Instead, a fat vacuolization occurs until the whole layer of cells is converted into sebum. In infections by *Malassezia*, the superficial cells of the scalp undergo this same degeneration, producing the greasy scales of dandruff. When *Malassezia* invades the sebaceous gland, it greatly hastens the production of sebum.

Since the sebaceous glands are not provided with a nerve supply, as are the sweat glands, the regulation of flow is dependent on heredity, race, age, sexual activity, customs and habits, diet, temperature, humidity, and perhaps acidosis. Heredity probably determines the number of these glands and their relationship to hair follicles and the function of the endocrine systems in general, for often greasy skins with tendencies to acne and baldness are common to several members of a single family. Little data regarding race have been accumulated that are not also explicable in connection with their habits and customs. Baldness is rare in women but, whether this is due to endocrine function or to the habit of wearing the hair long, thus preventing infection of the scalp, or the development of the organism by the higher humidity, is unknown. The fashion of wearing short hair is too recent in women to have yielded conclusive evidence on this point. If baldness is linked with the gonadal function, one would not expect an increase of baldness in women following the adoption of bobbed hair, while if long hair prevents infection, one would expect an increase.

When developmental processes in the fetus are at their height, the sebaceous glands are very active, producing a desquamating layer of fatty cells, the vernix caseosa. A few days after birth the vernix caseosa is shed, and the superficial layer begins to keratinize gradually. Here the *Malassezia* attacks the scalp and the pilosebaceous glands about the face, giving rise to the condition known as miliary sebaceous acne. More rarely it attacks the sebaceous glands of the front or the back of the chest, giving rise to grouped comedones. After the child is three years old, there is little chance of further infection until puberty, as the functions of these glands and of the gonads are in abeyance. At puberty, both glands again become active, the sebaceous glands, often predisposed to the infection by *Malassezia*, giving rise to pityriasis and acne. The complexion is muddy, the skin is coarse, greasy and thickened, the mouths of the sebaceous glands are large and those about the nose blacked by comedones. This condition (keratosis) may persist throughout the period of sexual activity, but it usually disappears in early adult life (about 25). Women are not prone to pityriasis but, in those suffering from acnes, there is often a relationship with the menstrual cycle and gonadal activity. In men, at the height of their sexual activity (between 30 and 40 years old), baldness appears on the scalp, and the infection extends to other portions of the body. Later in life we find sebaceous cysts and still later seborrheic warts. Sabouraud has attempted to correlate baldness with excessive activity shortly after puberty but the difficulty of measuring this activity and of securing reliable data is so great that his results are inconclusive.

Customs and habits often play a large part in the spread of the disease. Customs which tend to keep the skin very oily and in low humidity seem to favor its spread, such as anointing the scalp with oil, infrequent bathing, etc. The wearing of hats, often decried, seems to be unimportant; for example, the bareheaded, short-haired, middle class Bengali is very apt to be bald while the Pathan, with long hair, covered with a hard kulor and surrounded by a turban is practically free from baldness. Excessive amounts of carbohydrates and fats or of alcohol tend to increase the greasiness of the skin and predispose to infection as do warm, dry atmospheres.

In infancy, the lesions commence on the scalp as a greasy heaping up of scales, which are often colored dark from accumulated dirt. Thence the infection spreads to the face, typically over the flush area of the cheeks. Mild lesions consist of slightly desquamating areas with erythema. In severe cases there is usually secondary infection by streptococci. The lesions of the head and face frequently become infected by a secondary impetigo and the disease spreads rapidly over the scalp, face, behind the ears, neck, and even on the body. In some children the fungus may involve the forehead, producing tiny vesicles caused by blocking the sebaceous glands of this region. It may also extend to the flexures of the arms, the popliteal space, and the front of the legs. Since infants under three months are unable to scratch themselves, they relieve the irritation by rolling the back of the head and the sides of the face on the pillow, thus spreading the infection. The sebaceous glands are rarely infected in infancy and when they are, it is probably due to stoppage of their mouths by too liberal application of oils by the mother, with subsequent invasion by staphylococci.

From puberty until the twenty-fifth year, the organism growing on the scalp produces little or no symptoms beyond slight dandruff. During this period, the invasion of the pilosebaceous glands not connected with hairs is more common. The glands of the nasolabial folds, between the scapulae and those of the front of the chest are most frequently attacked, rarely those of the forehead (acne frontalis). In the mild cases, the skin becomes coarse and blackheads are formed, occasionally these are infected by staphylococci, giving rise to superficial inflammation (with or without pustules and papules). If the staphylococcal infection extends deep into the corium, it gives rise to deep abscesses, the skin over them is bluish and the abscesses are slow in coming to a head. Very rarely the suppuration may end in a localized necrosis somewhat similar to the formation of a carbuncle (acne necrotica). Such lesions are seen only in debilitated persons. The scars left by the rupture and absorption of these pustules also vary in different individuals. In superficial lesions, the scars are difficult to see after the inflammation has subsided. In deep lesions, the scars often leave little pitlike areas scattered over the cheeks and sides of the neck. Sometimes these scars undergo keloid formation, producing ugly raised keloids. More rarely the scar is deeply situated and gives rise to superficial atrophy of the skin overlying it, so that these atrophic scars are white, suggesting the morphea spots. In the last named conditions, the individual shows a lower basal metabolism, suggesting connection with hypofunction of the thyroid [hypophysis or gonad?].

In this period the dandruff scales are small, dry, and greasy, and adhere to the surface of the scalp. The skin is not inflamed and appears normal, but the hair is dry and has lost its luster. From time to time there are exacerbations (especially in hot dry climates). The skin becomes irritable, with small erythematous areas and excoriations, due to scratching. Extension occurs on the forehead where the skin becomes red and irritable (corona seborrhoeica). The sebaceous glands become involved, infected with staphylococci, giving rise to small vesicles which, if irritated by friction of the hat, may result in boils. Occasionally this may extend to the eyebrows and eyelashes. The sebaceous glands which are not pilosebaceous are rarely involved by *Malassezia*, but are infected by staphylococci, producing styes, exfoliative cheilitis of the lips, etc.

From 30 to 45 years of age, the *Malassezia* which has been largely restricted to the superficial layer of the scalp now invades the hair follicle and its sebaceous gland, after a few years destroying them and producing seborrheic alopecia or baldness. The area may start at the crown and spread or at the forehead and grow backward, until, when baldness is complete, only a narrow fringe is left at the back and sides of the head. At first the number of hairs is not diminished, but they become finer in texture and, as the follicles are destroyed, the space between the hairs increases, until all the follicles are destroyed and the scalp is thin, shiny, and bald. During and after middle age, extensions to the body are more common than in adolescence, when it extends to the forehead as corona seborrhoeica, rarely to the whole face. The skin becomes dry and harsh, thickened and indurated and from irritation of the corium, the melanoblasts and basal layers are stimulated with deepening of pigmentation. When the nape of the neck becomes involved, with the added irritation of collar and other clothing, the skin is thickened, indurated, with deep furrows where the normal lines of skin were (lichenification). More rarely pustules form and the scars become keloid (dermatitis papillaris capillitii. In elderly people *Malassezia* may also attack the skin at the flexures of the elbows and knees, producing lichenification or even acute exfoliative dermatitis.

Among the poorer classes of England, circinate lesions with a slightly inflamed base and greasy scales appear on the body, a condition known as flannel rash. During middle age the acneiform type of lesions tend to disappear. In acne rosacea, there is a reflex erythema on the nose or the face produced by some irritation in the upper portion of the alimentary canal, causing the skin to become red and thickened and the sebaceous glands to become hypertrophied. The latter are then invaded by *Malassezia,* with the production of papular lesions.

As a result of the irritation of the mouths of the sebaceous glands these are blocked and the sebum cannot find an outlet; as age advances the glands become enlarged from the accumulation of sebum, and retention cysts (wens) are formed. More rarely in adult life the moist skin of the axilla and scrotum is attacked, being covered with a layer of greasy scales, where retention of the secretion of the sebaceous glands and staphylococcal infection occur. Sometimes the glands of the scrotum become blocked, producing a condition similar to Fordyce's disease of the lips, with thickening, induration, and intense irritation, an eczematous condition whose diagnosis is to be carefully distinguished from tinea cruris.

In the tissues, *Malassezia* appears as a yeastlike budding form (the flask-shaped bacillus of Unna or the *Morococcus* of Sabouraud). During its growth it interferes with the flattening and the proper keratinization of the superficial cells of the scalp, and they are shed as the delicate scales of dandruff. When the disease is spreading rapidly, the scales separate rapidly, and only the yeast cells are seen. At middle age, the mouth of the hair follicle is invaded, the horny layer fails to keratinize, and the mouth of the follicle is filled with large swollen cells. The yeast cells divide rapidly at the bottom of the follicle and invade the sebaceous gland, while the leucocytes show an inflammatory reaction about the neck of the gland. The hair becomes distorted and the shaft is invaded by staphylococci. Deeper down, the root is surrounded by an inflammatory exudate and atrophies, the epidermis is thin and atrophied, and the corium consists of a dense white fibrous tissue, causing the glazed, scarred appearance of the skin of a bald head. The site of the follicle is occupied by a thin fibrous scar that has destroyed the hair root, leaving permanent baldness.

The sebaceous glands not connected with hair follicles are larger and more racemose. As *Malassezia ovalis* invades the mouth of the gland, it causes the cells of the mouth to disintegrate more rapidly than usual, because at this site there is very little normal transformation of horny cells to sebaceous material. The cells destroyed by the fungus are more resistant and block the mouth of the gland by a fatty plug; the external part is impregnated with dirt and forms the blackhead, filling the enlarged mouth of the sebaceous gland. The flow of sebum is blocked and collects behind the plug, distending the gland (comedo). This sebaceous plug, which on expression comes out as a little coiled "worm," has been called by Sabouraud the seborrheic cocoon. These plugs are completely soluble in ether. Often these plugs are filled with a fine felted mass of the acne bacillus, which has nothing to do with the disease but finds suitable conditions (fat and anaerobiosis) for growth as a secondary invader.

As a complication, the comedones may be infected by *Staphylococcus albus* or *S. aureus,* producing the acne pustules. In some individuals, part of the pustules become cicatrized superficially and give rise to keloid scars; in others, the cicatrization is deeper. The gland may become atrophic and its wall reduced to a single row of cells as a result of the excessive sebum formation. The inflammation may spread from the gland into the corium, usually without suppuration, giving rise to induration of the corium. The melanoblasts are irritated so that they secrete more pigment, producing a darkening of the skin (chloasma).

In the scales of relatively quiescent stages, the fungus cells are large, spherical, 8-12μ in diameter, showing occasionally smaller cells and some budding. In the active stage, the fungus cells are smaller, budding forms are numerous, 2-3μ in diameter in the resting stage. The cell and its adherent bud gave the picture described by Unna as his flask bacillus. When the cells are resting, they give the picture described by Sabouraud as *morococcus.* In the dandruff, some irregular hyphae are seen, 2-3μ in diameter and 15-20μ long; often slightly bent. As staphylococci in a given field increase, the number of *Malassezia* cells decrease.

Attempts to cultivate *Malassezia* on the usual laboratory media have been unsuccessful. Panja obtained his first successful cultures on Petroff's glycerol medium, an egg medium colored with 0.0004% gentian violet, to inhibit the staphylococci. The scales should be washed in sterile normal saline to free them from as many extraneous foreign organisms as possible. The washed scales are placed on the upper part of Petroff's medium where the slope has dried up. The primary colonies appear small, dry, and chalky, visible on the third day. Secondary cultures will grow on the thick part of Petroff's medium, which is still moist, on glucose agar, ordinary agar, and even on glucose broth.

Macleod & Dowling (1928) and Benedek (1930) have also claimed the culture of the bottle bacillus of Unna, but in no case have they established the pathogenicity of the organism cultivated. Benedek describes his organism as follows: Cells mostly spherical, hyaline, 7.8-10.4μ, solitary or rarely in small groups, forming neither hyphae nor spores. On Sabouraud's agar (pH 4.7-4.9) and on 8% glucose agar (pH 6.9-7.1), under strictly aerobic conditions, colony smooth, rounded and brown. He also reports growth on malt extract, glucose, and maltose broth, and acid formation with glucose, fructose, sucrose, and maltose solutions and on milk. No fermentation, no liquefaction of gelatin.

Ota & Huang (1933) report further details of cultures, using a strain isolated by Acton & Panja, *Cryptccoccus graciloides* Castellani and a strain isolated by Huang which they consider conspecific. Cells typically ovoid, although spherical and bottle-shaped forms may be seen, 2-2.5μ often united in pairs. Very rarely suggestions of arthrospores were observed, but probably no true arthrospores are produced. On egg medium at the end of several months, senescent cells are 3-5μ, thick-walled, usually solitary spherical, ovoid, or more or less angular, with a large central oil drop, sometimes occurring in short chains with a thin gelified sheath. No mycelium seen. Gram stain colors the protoplasm completely in young cells, less so in adults; Giemsa stain variable.

Petragni's medium found to be the most favorable, colonies becoming 1 mm. in diameter, becoming confluent, especially in moister portions, forming a crustose membrane, granular, moist, ivory white, finally brownish. Ten per cent glucose agar to which a little (about 10%) butter has been added is also favorable, slightly more so than Petroff's medium. On Sabouraud glucose, colonies very fine, suggesting those of *Neisseria*. On malt extract, a slight deposit, but no ring or pellicle. No ascospores observed No fermentation.

Ota & Huang were unable to prove the pathogenicity of their strains (intravenous and intraperitoneal injections!).

Moore (1934) succeeded in isolating *Malassezia* on wort agar, proving its pathogenicity. Growth is very slow at first but increases after repeated subculture on this medium. He describes his cultures as follows:

On Sabouraud agar, colony flat, light ochraceous salmon, dull with slight ridges at the margin, cells spherical, 3-10μ mostly 4-5μ in diameter. On wort agar, colony pulvinate with radial ridges, surface rough, light ochraceous salmon to pinkish buff, dull cells 3-15μ mostly 4-5μ, bottle-shaped cells common, the larger cells with a thick capsule. On malt extract agar, colony pinkish cinnamon with a circular flat plateau in the center with fine radial ridges. Cells spherical or ovoid, 2-7μ mostly 4-5μ. On Raulin's agar and Richard's agar, growth similar but very poor. On corn meal agar colony ochraceous buff, slightly glistening, ridges faint, margin irregular. Long cells occasional. On potato glucose agar colony pulvinate, waxy, pinkish buff, cells spherical to ovoid, mostly bottle-shaped, 2-6μ mostly 4μ. On Maneval's modification of

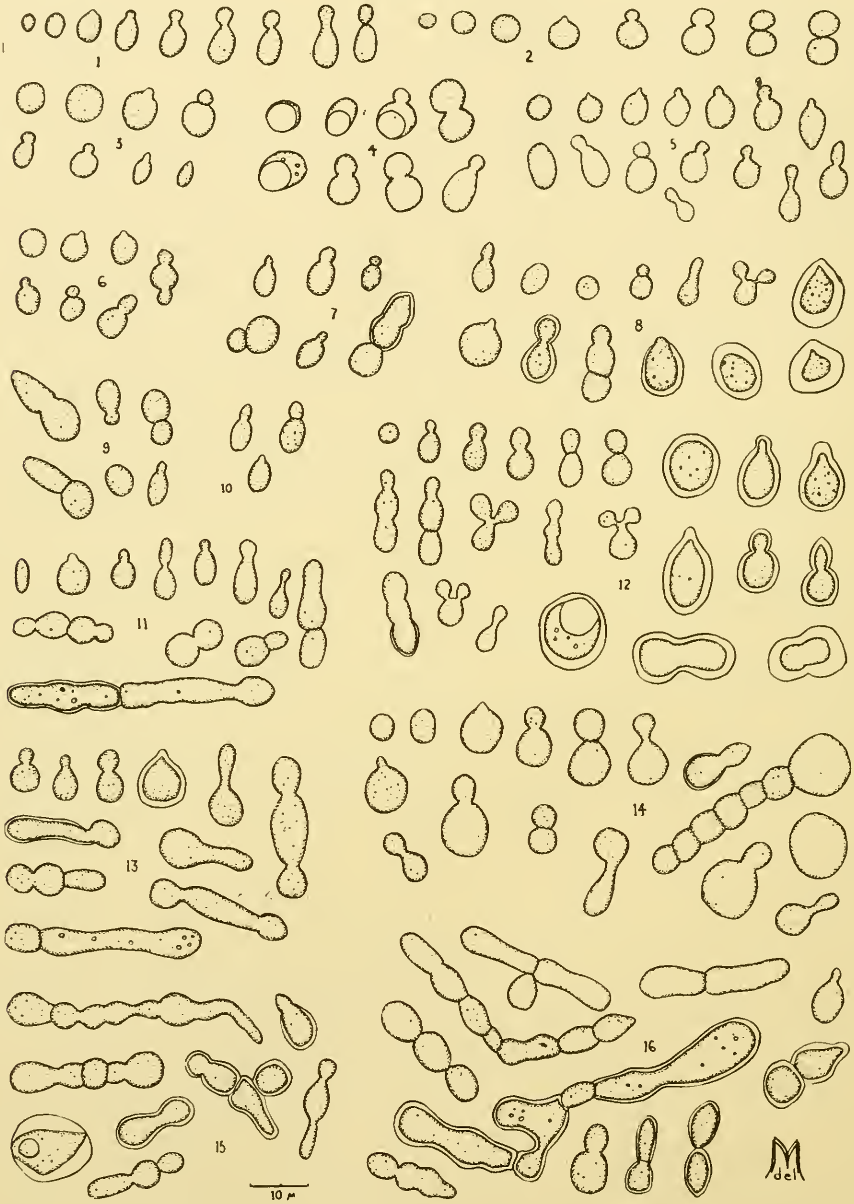

Fig. 70.—*Malassezia ovalis.* *1,* development of ovoid cells; *2,* development of spherical cells; *3,* both types of cells on serum agar; *4,* on Richards' agar; *5,* on Malt extract agar; *6,* on blood agar, bipolar sprouting; *7,* thick-walled form on yeast-glucose agar; *8,* on Sabouraud agar; *9,* on corn meal agar; *10,* bottle forms on potato glucose agar; *11,* on Maneval modification of Gorodkova agar; *12,* on wort agar; *13,* on glycerol agar; *14,* on Raulin's agar; *15,* in lactose broth; *16,* in Sabouraud broth.

Gorodkova agar, colony similar, light ochraceous salmon, cells similar but some long cells present. On lactose broth agar and nutrient agar, colony flat, or slightly elevated, cinnamon buff, cells spherical, 2-5μ. On lactose broth agar, colony pulvinate, light ochraceous buff, cells 4.5μ, spherical or ovoid. On glycerol agar, colony light ochraceous salmon, smooth, glistening, radial ridges, pulvinate. Cells spherical or ovoid, 2-7μ with long cells. On yeast glucose, colonies similar, cells spherical, 2-5μ, sometimes clinging together in short chains of 3 cells with few long cells. On serum agar, growth poor, colony dull and pasty, ochraceous buff. On blood agar, colony glistening or waxy, pinkish buff, appearance of that on malt extract agar. On peptone broth, no pellicle or ring, sediment shows cells spherical to ovoid, 3-9μ mostly 5μ in diameter, forming chains 3-5 × 12-15μ with many thick-walled cells. On lactose broth, similar, but spherical cells up to 12μ in diameter with long cells suggesting catenulate conidia, ovoid cells about 6μ in long axis, larger cells thick-walled (Fig. 70).

Therapeusis.—As with other fungus infections, there is no simple treatment and the standard texts should be consulted. Since the dandruff scales of the scalp form a reservoir of both *Malassezia ovalis* and staphylococcus, any treatment should be aimed at their complete removal to prevent reinfection. When this has been accomplished, the mouths of the sebaceous glands may be softened by an appropriate lotion and the comedones expressed. Staphylococcus infections may be cleared up by vaccines, although vaccines alone without an attempt to get rid of the dandruff scales as a reservoir of reinfection are of very uncertain value.

Malassezia Macfadyeni Castellani, 1908.

Microsporon Macfadyeni Castellani, Brit. Med. Jour. 1905, **2**: 1272, *1 fig.*, 1905; Trans. Internat. Derm. Congr. **6**: 661, 1908; Jour. Trop. Med. Hyg. **10**: 65-66, 1907.

Trichophyton Macfadyeni Castellani, Jour. Cut. Dis. **26**: 396-397, 1908.

Trichophyton Macfadyeni Castellani, Jour. Trop. Med. Hyg. **11**: 261, 1908.

Atrichophyton Macfadyeni Castellani & Chalmers, Man. Trop. Med. ed. 3, 1009, 1919.

Found present in cases of pityriasis alba.

Hyphae slender, short threads of regular outline; spores small 3-3.5μ in diameter, ovoid, sometimes appearing in large clusters.

Cultivated twice for short period on Sabouraud maltose agar, gave colonies of very slow growth, deeply pitted yellowish mass, very firmly and deeply rooted in medium. Transfers always failed.

Malassezia tropica (Castellani) Schmitter, Jour. Trop. Med. Hyg. **26**: 194, 1923.

Microsporum tropicum Castellani, Brit. Med. Jour. 1905, **2**: 1271-1272, 1905; Trans. Internat. Derm. Congr. **6**: 661, *Pl. 44*, 1908; Jour. Trop. Med. Hyg. **10**: 65-66, 1907; Jour. Cut. Dis. **26**: 396, 1908.

Appears in tinea flava or pityriasis flava. Not cultivated by Castellani.

Spores spherical or ovoid, 3.5-4.5μ, thick-walled.

No white spots or craters on surface of glycerol agar cultures. Indol not produced. Litmus in broth strongly decolorized. No acid formation in lactose broth.—Schmitter.

Malassezia pachydermatis (Weidman) Dodge, n. comb.

Pityrosporum pachydermatis Weidman in Fox, Rept. Lab. Mus. Comp. Path. Zool. Soc. Philadelphia 36, 1925.

Pityrosporum rhinoserosum Sabouraud in Lodder, Anaskosporogenen Hefen **1**: 189, 1934.

Isolated from scaling of the skin of *Rhinoceros unicornis* in the Zoological Garden in Philadelphia.

In scales, cells small, sprouting, polar. In malt extract, cells ovoid or flask-shaped, 1.5-3 × 2.5-5μ, sprouting over a broad base, polar.

Growth very slow, elevated, center pointed, dark yellowish, thick, surface smooth, regular, dull. On malt agar, colony brown, margin lighter, dull, somewhat irregular surface, margin smooth. On malt gelatin, colony gray, dull, smooth, margin irregular. On malt extract, a few islets, a thin ring, and granular sediment. On alcohol, a few thin islets. No fermentation; gelatin liquefied after 12 weeks.

Doubtful Species

Mycoderma Dombrayi Vuillemin, C. R. Acad. Sci. **189**: 405-406, 1929.

Isolated from white pityriasis of the skin of penis and scrotum of a dermatologist.

The scales show filaments varying from 3-6.75μ in diameter with chlamydospores; same appearance on liquid media. Chlamydospores reach a diameter of 14μ on germination.

BIBLIOGRAPHY

The following articles relating to Hemispora infections were overlooked when this genus was transferred from the Toruleae at a late stage in the preparation of this work: Falchi 1925, see p. 689; Fonseca & Arêa Leão 1927, see p. 689; Porcelli 1922, see p. 692; Sartory, Meyer & Meyer 1930, see p. 692, and Vuillemin 1906, see p. 693.

Aars, C. G. 1930. Piedra, *Arch. Derm. Syphilol.* 22: 401-409, *9 figs.*

Acton, Hugh W. 1918. The diagnosis of acute infections of the throat occurring amongst troops of the Mesopotamian Expeditionary Force, *Indian Jour. Med. Res.* 6: 152-156.

—. 1919. Mycotic infections of the throat due to Endomyces tropicalis, *Indian Jour. Med. Res.* 6: 591-600, *4 pls.*

Acton, Hugh W. & Ganapati Panja. 1927. Seborrheic dermatitis or pityriasis capitis: a lesion caused by Malassezia ovale, *Indian Med. Gaz.* 62: 603-614, *10 pls.*

Agostini, Angela. 1932. Observations on fungi found in cases of North American blastomycosis of the skin and lungs, *Jour. Trop. Med. Hyg.* 35: 266-269, *3 figs.*

—. 1934. Su due ifomiceti isolati da micosi umane. Blastomicoides immitis (Rixford & Gilchrist) Castellani e Blastomycoides tulanensis Castellani, *Atti Ist. Bot. R. Univ. Pavia* IV, 4: 9-15, *3 figs.*

Agostini, Angela & Stefania Brunetto. 1934. Osservazioni sul Debaryomyces Guilliermondii Dekker, isolato da una forma clinica umana, *Atti. Ist. Bot. R. Univ. Pavia* IV, 4: 41-47, *3 figs.*

Ahlfeldt, Florence E. 1926. Studies in coccidioidal granuloma: mode of infection, *Arch. Path.* 2: 206.

—. 1929. Special observations on the morphology of Coccidioides immitis, *Jour. Infect. Dis.* 44: 277-281, *2 pls.*

Aichelburg, U. 1932. Osservazioni sulle proprietà biochimiche di alcune specie di Monilia, *Boll. Ist. Sieroterapico Milano* 11: 577-584.

Aievoli, Eriberto. 1895. Osservazioni preliminari sulla presenze di blastomiceti nei neoplasmi, *Policlinico, Sez. Chirurg.* 2: 429-438.

—. 1895. Nuova contribuzione allo studio dei blastomiceti nei neoplasmi, *Riforma Med.* 9: 604-606.

—. 1896. Ricerche sui blastomiceti nei neoplasmi, *Centralbl. Bakt.* I, 20: 745-749, *1 pl.*

Akagi, S. 1929. Ueber eine neue mykotische Hautkrankheit, Trichosporia cutis psoriatiformis progressiva Asahi et Akagi, *Jap. Jour. Derm. Urol.* 29: 733-773 [53-55].

Alatorzeff, A. P. 1931. Zur Frage der Dermatomykosis hervorgerufen durch Torula Epizoa Corda, *Arch. Derm. Syphilis* 164: 279-284, *2 figs.*

Alexander, Arthur. 1922. Beiträge zur Klinik und Diagnose der Soorerkrankungen der Haut, *Derm. Woch.* 75: 1125-1131.

*Alfonso, José. 1931. Algunas consideraciones sobre blastomicosis, *Bol. Soc. Cubana Derm. Sifilogr.* 2: 129.

Almeida, Floriano Paulo de. 1928. Sobre a localisação cutanea da blastomycose em uma cobaya inoculada experimentalmente no testiculo, *Sciencia Med.* 6: 173, 174, *1 pl.*

—. 1928. Lesões cutaneas da blastomycose em cobayos experimentalmente infectados, *Annaes Fac. Med. São Paulo* 3: 59-64, *6 figs.*

—. 1929. Estudo comparativo do granuloma coccidioidico nos Estados Unidos e no Brasil. Comparative study of coccidioidal granuloma in the United States and Brazil, *Annaes Fac. Med. São Paulo* 4: 91-98, *4 pls.*

—. 1929. Aspectos histologicos observados em casos de blastomycoses occorridos em São Paulo, *Brasil Med.* 43: 485-489, *30 figs.*

—. 1930. Estudos comparativos do granuloma coccidioidico nos Estados Unidos e no Brasil. Novo genero para o parasito brasileiro, *Annaes Fac. Med. São Paulo* 5: 3-19, *9 pls.* [Différence entre l'agent etiologique des États Unis et celui de Brésil. Nouveau genre pour le champignon brésilien, *C. R. Soc. Biol.* 105: 315, 316, 1930.]

—. 1932. Contribuicão para o estudo da morphologia do Coccidioides immitis nos tecidos parasitados, *Annaes Fac. Med. São Paulo* 7: 117-123, *3 pls.* [1-9].

—. 1932. Considerações em torno do Coccidioides immitis e do Pseudococcidioides Mazzai, *Annaes Fac. Med. São Paulo* 8: 83-91, *10 pls.* [1-11]. [Considérations sur les genres Coccidioides immitis et Pseudococcidioides Mazzai, *C. R. Soc. Biol.* 110: 137, 138, 1932.]

—. 1933. As blastomycoses no Brasil, *Annaes Fac. Med. São Paulo* 9: 69-163, *30 pls.* [1-97].

—. 1933. Blastomicoses em geral e sua classificação. Definição e classificação das blastomicoses, *Rev. Ass. Paulista Med.* 3: 270-277.

—. 1933. Notas sobre a morphologia do Paracoccidioides brasiliensis nos tecidos parasitados, *Revista Biol. Hyg.* 4: 103-106.

—. 1933. The influence of temperature upon the aspect of the cultures of the Paracoccidioides brasiliensis, *Revista Biol. Hyg.* 4: 107, 108.

—. 1934. Le blastomicosi nel Brasile, *Folia Clin. Biol.* 6: 1-15, *6 figs.*

Almeida, Floriano Paulo de & Inah de Camargo. 1933. Agente etiologico do ''sapinho''—Estomatite cremosa ou pseudomembranosa, *Revista Biol. Hyg.* 4: 104-106.

Almeida, Floriano Paulo de & Lourival F. dos Santos. 1927. Sobre um caso de blastomycose pulmonar, *Annaes Fac. Med. São Paulo* 2: 221-227.

Alvarez, Ruth Stone. 1926. A red Torula as the cause of a tongue abnormality, *Jour. Am. Med. Ass.* 87: 1358, 1359.

Anderson, Charles, J. Colas-Belcour, & R. Broc. 1930. Sur un nouveau cas de blastomycose observé en Tunisie, *Arch. Inst. Pasteur Tunis* 19: 317-322.

Anderson, Harry Warren. 1917. Yeast-like fungi of the human intestinal tract, *Jour. Infect. Dis.* 21: 341-387, *Pls. 3-8.*

Anna, Enrico de. 1895. I blastomiceti negli epiteliomi, *Policlinico, Sez. Chirurg.* 2: 471-484, *1 pl.*

Antoine, Edouard. 1917. De l'infection par mycoses dans les plaies de guerre, *Bull. Mém. Soc. Chirurg. Paris* 43: 1300-1304.

—. 1918. Étude morphologique et expérimentale d'un Oospora pathogène (Oospora Perieri Matruchot et Antoine), *Ann. Inst. Pasteur* 32: 202-214.

Ariaz, C. Orol. 1925. La pierre de l'Argentine, *Giorn. Ital. Derm. Sifilol.* 66: 1025-1032, *Pls. 1-3.*

Artault, Stephen. 1898. Flore et faune des cavernes pulmonaires, *Arch. de Parasitol.* 1: 216-307. [Champignons pp. 258-273.]

Arzt, L. 1925. Zur Klinik und Pathologie der Sprosspilzerkrankungen, *Arch. Derm. Syphilis* 148: 478-488, *12 figs.*

Ascher, L. 1900. Über Rhodomyces erubescens nebst einem Beitrage zur Lehre von der Disposition, *Zeitschr. Hyg. Infektionskrankh.* 34: 475-481, *Pl. 4.*

Ashford, Bailey K. 1915. A Monilia found in certain cases of sprue. Preliminary note, *Jour. Am. Med. Ass.* 64: 810, 811.

—. 1915. Relation of the genus Monilia to certain fermentative conditions of the intestinal tract in Porto Rico, *Jour. Am. Med. Ass.* 64: 1893-1896.

—. 1915. Studies in moniliasis of the digestive tract in Porto Rico, *Am. Jour. Med. Sci.* 150: 680-692.

—. 1915. Is sprue a moniliasis of the digestive tract? *Am. Jour. Trop. Dis. Prevent. Med.* 3: 32-46.

—. 1916. Further experimentation on animals with a Monilia commonly found in sprue, *Am. Jour. Med. Sci.* 151: 520-528.

—. 1917. The etiology of sprue, *Am. Jour. Med. Sci.* 154: 157-176.

—. 1921. La carencia de ciertos elementos alimentos como causa predisponente del espru, pelagra y beriberi en Puerto Rico, *Bol. Ass. Méd. Puerto Rico* 15: 249-259.

—. 1922. Observations on the conception that sprue is a mycosis superimposed upon a state of deficiency in certain essential food elements, *Am. Jour. Trop. Med.* 2: 139-150.

—. 1923. A clinical investigation of tropical sprue, *Am. Jour. Med. Sci.* 165: 157-173.

—. 1924. Tropical sprue in Porto Rico—a synthesis of fifteen years' work of investigation and 2,200 cases, *Internat. Conf. Health Prob. Trop. Amer. United Fruit Co.*, pp. 686-708.

—. 1925. Sprue, *Ann. Clin. Med.* 4: 13-20.

—. 1928. Certain conditions of the gastro-intestinal tract in Porto Rico and their relation to tropical sprue, *Am. Jour. Trop. Med.* 8: 507-538.

—. 1929. Mycology of the intestinal canal in Porto Rico and its relation to tropical sprue, *Jour. Am. Med. Ass.* 93: 762-765, *3 figs.*

—. 1929. La mycologie du canal intestinal à Porto Rico et ses relations avec la sprue tropicale, *Bull. Soc. Path. Exot.* 22: 58-60.

—. 1929. The present state of mycology in medical science, *Porto Rico Jour. Public Health & Trop. Med.* 5: 33-35.

—. 1929. Suggestions for a rapid classification of the anemias of sprue and nutritional unbalance in the tropics, *Porto Rico Jour. Public Health & Trop. Med.* 5: 167-184.

—. 1929. The anemias of sprue: their nature and treatment, *C. R. Congr. Internat. Méd. Trop. et d'Hyg. Cairo* 2: 345-441.

—. 1930. Significance of mycology in tropical medicine, *Arch. Derm. Syphilol.* 22: 7-33.

—. 1932. The differential diagnosis of sprue and pernicious anemia, *Am. Jour. Trop. Med.* 12: 199-215.

Ashford, Bailey K. & Raffaele Ciferri. 1930. A new species of Torulopsis: T. nitrophila Cif. & Ashford, *Centralbl. Bakt.* II, 81: 63-67, *1 fig.*

Ashford, Bailey K. & Everett W. Lord. 1930. A severe case of tropical sprue, *Porto Rico Jour. Public Health & Trop. Med.* 5: 268-277.

Ashworth, J. H.: 1924. On Rhinosporidium Seeberi (Wernicke 1903) with special reference to its sporulation and affinities, *Trans. R. Soc. Edinburgh* 53:2: 301-342, *Pls. 1-5.*

Askanazy, M. 1920. L'étiologie et la pathogénie de l'ulcère rond de l'estomac, *Rev. Méd. Suisse Romande* 40: 477-485.

Askanazy, M., et al. 1921. Über Bau und Entstehung des chronischen Magengeschwürs sowie Soorpilzbefunde in ihm, *Arch. Path. Anat. Phys.* [Virchow] 234: 111-178, *2 pls.*

Assimis. 1921. La pneumonie à Monilia à propos d'un cas observé en Grèce, *Bull. Méd.* [Paris] 35: 969, 970.

Audry, Ch. 1887. Sur l'évolution du champignon du muguet, *Rev. Méd.* 7: 586-595.

Axamit, Oskar. 1907. Über Empfindlichkeitserscheinungen nach Hefeinjektionen, *Arch. Hyg.* 62: 15-54, *Pl. 1.*

*Ayyar, V. K. 1932. Rhinosporidiosis in equines, *Indian Jour. Vet. Sci. Anim. Husb.* 11: 49-52, *11 figs.*

Bachmann, W. 1921. Ein Fall von Soorvarietät, *Centralbl. Bakt.* I, 86: 129-132.

Backofen, Otto. 1933. Zur Frage des Schizosaccharomyces hominis Benedek, *Derm. Woch.* 97: 1055, 1056.

Badham, Charles. 1922. Preliminary report on the causal organism of blastomycotic meningitis in Australia, *Med. Jour. Australia* 9: 2:385.

Baginsky, A. 1885. Über Soorkulturen, *Deutsch. Med. Woch.* 11: 867.

Bagnacci, Carlo. 1926. Su di un caso di glossite in un bambino tifoso con reperto di Cryptococcus ruber (Demne) Vuill., *Atti R. Accad. Fisiocrit. Siena* X, 1: 9, 10.

Bahr, Philip Heinrich. 1914. Researches on sprue 1912-1914, *Jour. Trop. Med. Hyg.* 17: 203-208. [*Trans. Soc. Trop. Med.* 7: 161-193, *8 figs.*]

—. 1915. Report on researches on sprue in Ceylon. Cambridge, 155 pp., *8 pls.*

Bailey, Richard & Leon Goldman. 1934. Cutaneous reactions with purified Oidiomycin, *Arch. Derm. Syphilol.* 29: 564-568.

*Baliña, P. L. & Pablo Negroni. 1930. Intertrìgo interdigital y onixis debidas a un nuevo parásito, *Assoc. Argentina. Derm. Sif.*

—. 1932. Intertrigo des orteils et onyxis dus a un nouveau parasite, *Ann. Derm. Syphiligr.* VII, 3: 8-20, *11 figs.*

Ball, H. A. 1930. Human Torula infections—a review. Report of cases, *California West. Med.* 32: 338-346, *8 figs.*

Balls, A. K. 1925. The precipitin test in the identification of yeasts, *Jour. Immunol.* 10: 797-802.

Balog, Paul & Gino Grossi. 1929. Allergie der Haut bei Lungenmoniliasis, *Arch. Derm. Syphilis* 157: 549-554.

Balozet, L. 1931. Deux cas de moniliase bronchique, *Bull. Soc. Path. Exot.* 24: 15-17.

Balzer, F. & Belloir. 1913. Un cas d'hémisporose, *Bull. Soc. Franç. Derm. Syphiligr.* 24: 129-132.

Balzer, F., H. Gougerot & René Burnier. 1912. Nouvelle mycose: parendomycose gommeuse ulcéreuse, due à un parasite nouveau, le Parendomyces Balzeri, *Ann. Derm. Syphiligr.* V, 3: 282-295, *4 figs.*

—. 1912. Dermatomycose végétante disseminée due au Mycoderma pulmoneum, *Ann. Derm. Syphiligr.* V, 3: 461-482, *13 figs.*

*Bang. 1923. Die epizootische Lymphangitis des Pferdes, *Deutsch. Tierärztl. Woch.* 169.

Bardelli, P. C. 1927. Sulla natura del virus della linfangite cryptococcica et sulla sua asserite filtrabilità, *Ann. Ig.* 37: 857-862.

Bardelli, P. C. & A. Ademollo. 1927. Sulla resistenza della colture di Criptococcus farciminosus Rivolta agli agenti fisici e chimici, *Ann. Ig.* 37: 81-85.

*Bardelli, P. C. & V. Cilli. 1931. Osteomielite tibiale primitiva di origine centrale da Cryptococcus farciminosus Rivoltae, *Clinica Veter.* 1: [*Bull. Inst. Pasteur.* 30: 385, 1932].

Barlaro, Pablo M. & Silvio Parodi. 1920. Sobre un caso de broncomicosis, *Prensa Méd. Argentina* 7: 15-17.

Barlow, D. L. 1923. Primary blastomycotic meningitis occurring in a child, *Med. Jour. Australia* 10:2: 302-304.

Baron, L., J. Magrou & J. Valtis. 1925. Onychomycose à Pityrosporum ovale, *C. R. Soc. Biol.* 92: 557, 558.

Barotte, J. & H. Velu. 1924. Essais d'isolement en cultures du cryptococque de la lymphangite épizootique du cheval par l'emploi de milieux à l'acid citrique, *Bull. Soc. Path. Exot.* 17: 540-543.

Basgal, Waldemar. 1931. Contribuição ao estudo das blastomicoses pulmonares. *Thesis, Instituto Oswaldo Cruz. Rio de Janeiro.* 156 pp., *21 pls.*

Bassewitz, Ernesto von. 1929. A Piedra no Rio Grande do Sul, *Brasil Med.* 43: 982, 983.

Bassoe, Peter. 1906. Disseminated blastomycosis. Report of a case involving the lungs, lumbar vertebrae and subcutaneous tissues with multiple abcesses and fistulae and extensive amyloid degeneration, *Jour. Infect. Dis.* 3: 91-101.

Bastedo, W. A. & L. W. Famulener. 1923. Tropical sprue, a critical study of cases, *Jour. Am. Med. Ass.* 81: 2102-2108.

Baumgartner, Edwin A. & Glenn D. Smith. 1926. Monilia psilosis as a cause of tropical sprue, *Am. Jour. Trop. Med.* 6: 433-441.

Beattie, James M. 1906. Rhinosporidium kinealyi, a sporozoon of the nasal mucous membrane, *Jour. Path. Bact.* 11: 270-275, *Pls. 14, 15.*

—. 1907. A sporozoon in aural polypi, *Brit. Med. Jour.* 2: 1402, 1403.

Beauverie, J. & Ch. Lesieur. 1912. Étude sur quelques levures rencontrées chez l'homme dans certains exsudats pathologiques, *Jour. Physiol. Path. Gén.* 14: 983-1008.

Beck, M. Dorothy. 1929. Occurrence of coccidioides immitis in lesions of a slaughtered animal, *Proc. Soc. Exper. Biol. & Med.* 26: 534-536.

—. 1931. Diagnostic laboratory procedure [and] epidemiology [of coccidioidal granuloma]. *California Dept. Public Health Special Bull.* 57: 16-43.

Beck, M. Dorothy., J. Traum & Eileen S. Harrington. 1931. Coccidioidal granuloma. Occurrence in animals—reference to skin tests, *Jour. Am. Vet. Med. Ass.*, N. S. 31: 490-499, *1 map.*

Beck, S. C. 1910. Über das Erythema mycoticum infantile, *Derm. Stud.* 20: 494-505. [P. G. Unna Festschrift.]

Becker, S. William & K. B. Muir. 1929. Tinea amiantacea, *Arch. Derm. Syphilol.* 20: 45-53.

Becker, S. William & Earl B. Ritchie. 1930. The rôle of yeasts in the production of superficial dermatitis, *Arch. Derm. Syphilol.* 22: 790-802.

Beeson, B. Barker & James G. Church. 1926. Superficial yeast infections of the skin and of its appendages, *Arch. Derm. Syphilol.* 13: 643-657.

Behrend, Gustav. 1886. Über Knotenbildung am Haarschaft (mit Zugrundelegung eines Vortrags gehalten in der Berliner medizinischen Gesellschaft am 18 Februar, 1885), *Arch. Path. Anat. Phys.* [Virchow] 103: 437-460, *2 pls.*

—. 1890. Über Trichomycosis nodosa (Juhel Renoy); Piedra (Osorio), *Berlin. Klin. Woch.* 27: 464-467.

—. 1891. Über Trichomycosis nodosa, *Arch. Derm. Syphilis* 23: 994, 995.

Beintema, K. 1933. La pseudo-bromuride de Brocq, Pautrier et Fernet, une blastomycose, *Ann. Derm. Syphiligr.* VII, 4: 399-423, *14 figs.*

*Belou, P. 1903. Tratado de parasitologia animal ed. 1, Buenos Aires.

Bencini, A. & E. Federici. 1928. Su due nuove specie di miceti rinvenuti nella cornea, *Atti R. Accad. Fisiocrit. Siena* 3: 743-766, *8 figs.*

Benda. 1907. Ein Fall von Blastomykosis cerebri. *Deutsche Med. Woch.* 33: 945, 946.

Benedek, Tibor. 1925. Über isolierte Vulvovaginitis Oidiomycetica und Balanoposthitis oidiomycetica als konjugale Infektion bei einem gesunden Ehepaare, *Derm. Woch.* 80: 435.

—. 1926. Über Schizosaccharomykose, eine neue Hefepilzerkrankung verursacht durch eine neuentdeckte Spalthefe, *Arch. Derm. Syphilis* 152: 109, 110.

—. 1927. Schizosaccharomyces hominis n. sp. der erste menschenpathogene Spalthefe, *Centralbl. Bakt.* I, 104: 291-303, *2 pls.*

—. 1928. Schizosaccharomycosis sycosiformis. Beitrag zur Ätiologie und Pathogenese der sogenannten Sycosis simplex s. non parasitaria, *Derm. Woch.* 86: 425-433.

—. 1928. Schizosaccharomykid. Beitrag zur Ätiologie und Pathogenese der Pityriasis rosea Gibert, *Derm. Woch.* 86: 536-538.

—. 1928. Bemerkungen zum Züchtungsverfahren des Schizosaccharomyces hominis I, *Derm. Woch.* 87: 1203-1214.

—. 1928. Über experimentelle Schizosaccharomykose, *Derm. Woch.* 87: 1890-1893.

—. 1928. Über immunologischer Vorgänge bei der Schizosaccharomykose (Spalthefemykose), *Acta Dermato-Venereol.* 9: 76-97.

—. 1928-1929. Über Schizosaccharomykose (Spalthefemykose), I. Ätiologie, Pathogenese, Klinik, Serumdiagnose, Allergie, *Arch. Derm. Syphilis* 156: 186-201, 1928; II. Übertragungsversuche, Histologie, Therapie, *Ibid.* 157: 483-504, 1929.

—. 1929. Bemerkungen zum Züchtungsverfahren des Schizosaccharomyces hominis II, *Derm. Woch.* 88: 611-621.

—. 1929. Schizosaccharomycosis pompholiciformis. Zur Ätiologie und Pathogenese der dysidrosiformen palmaren und plantaren Mykosen, *Derm. Woch.* 89: 1355-1357.

—. 1930. Schizosaccharomykid mit pityriasiformen und pompholyziformen Effloreszenzen (Pityriasis rosea Gibert und Pompholyx Hutchinson), *Derm. Woch.* 90: 633-641.

—. 1930. Cryptococcus Malassezi (Pityrosporon Malassezi Sabouraud 1895), *Centralbl. Bakt.* I, 116: 317-332, *1 pl.*, *1 fig.*

—. 1931. Über Spalthefebefunde beim seborrhoischen Ekzem, *Derm. Zeitschr.* 60: 331, 332.

—. 1931-1932. Bemerkungen zum Züchtungsverfahren des Schizosaccharomyces hominis Benedek 1927. III. Die directe Blutkultur. Das makro- und mikroscopische Bild, *Acta Dermato-Venereol.* 12: 38-80, *24 figs.* IV. Die indirekte Blutkultur (Die Cantharidinblasemethode), *Ibid.* 13: 150-200.

—. 1931-1932. Schizosaccharomycosis. I. The present status of the identification of Schizosaccharomyces hominis and its results, *Arch. Derm. Syphilol.* 24: 557-579. II. Clinical (mycide) forms: pityriasis rosea of Gibert; its etiology and pathogenesis, *Arch. Derm. Syphilol.* 26: 397-418, *10 figs.*

—. 1932. Über den Nachweis des Schizosaccharomyces hominis Benedek 1927 eines standigen Endoparasiten des Homo sapiens im Nabelschnurblut, *Zeitschr. Geburtsh.* 104: 119-140, *6 figs.*

—. 1933. Histologischer Nachweis der Schizosaccharomyces hominis in der Nabelschnur (Funiculus umbilicalis), *Derm. Woch.* 97: 1653-1658, *6 figs.*

Benedek, Tibor & Richard Frühwald. 1928. Ein Fall von Schizosaccharomykose, *Derm. Woch.* 87: 1566-1577.

Benedek, Tibor & U. Greif. 1930. Beitrag zur Kenntnis und Therapie des pompholyziformen Schizosaccharomykids (sog. echte, amykotische Dysidrosis), *Derm. Woch.* 90: 166-177.

Benedek, Tibor & Alice Reinhardt. 1934. Weitere Untersuchungen zur Serodiagnostik der Schizosaccharomykosen, *Zentralbl. Bakt.* I, **131**: 212-222.

Benham, Rhoda W. 1931. Certain Monilia parasitic on man; their identification by morphology and by agglutination, *Jour. Infect. Dis.* **49**: 183-215.

Benham, Rhoda W. & Anne McH. Hopkins. 1933. Yeastlike fungi found on the skin and in the intestines of normal subjects. A survey of 100 persons, *Arch. Derm. Syphilol.* **28**: 532-543, *7 figs.*

Bennett, John Hughes. 1842. On the parasitic structures found growing in living animals, *Trans. R. Soc. Edinburgh* **15**: 2:277-294, *Pls. 6, 7.*

*Bennett, S. C. J. 1931. Cryptococcus pneumonia in Equidae, *Jour. Comp. Path. Therap.* **44**: 85-105, *7 figs.*

*—. 1932. Epizootic lymphangitis: mycelial forms of the parasite in a natural case, *Jour. Comp. Path. Therap.* **45**: 158-160, *3 figs.*

Berendsen, Ida. 1919. Weitere Mitteilungen über Erosio interdigitalis blastomycetica, *Arch. Derm. Syphilis* **126**: 751-763. Also *Inaug. Diss. Friedrich-Wilhelms Univ. Berlin* 27 pp. 1918.

*Berg, F. Th. 1842. *Svenska läkaresällskapet, Nya Handl.*

*—. 1848. Über die Schwämmschen bei Kindern, Bremen.

Berghausen, Oscar. 1927. Torula infection in man, *Ann. Int. Med.* **1**: 235-240, *2 figs.*

Berkhout, M. 1923. Die Schimmelgeschlachten Monilia, Oidium, Oospora en torula, Schweningen, 72 pp.

Bernstein, F. 1930. Über die Spalthefebefunde beim seborrhoischen Ekzem, *Derm. Zeitschr.* **59**: 385-394.

Bernstein, Richard. 1903. Zur Frage der Pathogenität der Blastomyceten bei Menschen, *Zeitschr. Klin. Med.* **49**: 456-460, *Pl. 3.*

Bertaccini, Giuseppe. 1934. Contributo allo studio della cosidetta Blastomicosi sudamericana, *Giorn. Ital. Derm. Sifilol.* **75**: 783-828, *Pls. 1-9.*

Bertarelli, E. & U. Calamida. 1901. Über die aetiologische Bedeutung der Blastomyceten in den Tonsillen, *Centralbl. Bakt.* I, **30**: 60-65, *2 pls.*

Bethe [Johann Friedrich], Wilhelm. 1899. Über pathogene Hefe, *Inaug. Diss. Med. Fac. K. Univ. Greifswald,* 55 pp.

Bettin, Mona E. 1924. Report of a case of Torula infection, *Calif. West. Med.* **22**: 98-101.

Beurmann, Lucien de & H. Gougerot. 1909. Les Exoascoses, *Tribune Méd.* **42**: 501-505, 517-524.

—. 1910. Eine neue Mykose, die Hemisporose [tr. Robert Stein], *Arch. Derm. Syphilis* **101**: 297-310, *Pls. 12, 13.*

Beurmann, Lucien de, H. Gougerot, & Vaucher. 1910. Oidiomycose gommeuse ulcéreuse disseminée, mycose nouvelle due à un parasite nouveau, l'Oidium cutaneum (ancien groupe des blastomycoses), *Rev. Méd.* **30**: 937-958.

Beurmann, Lucien de, Clair & H. Gougerot. 1909. Une nouvelle mycose, l'hémeisporose, un cas d'hémisporose de la verge, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **27**: 917-919.

Bianchi, Andrés E. & Flavio L. Niño. 1928. Sobre un caso de blastomicosis pulmonar per Monilia n. sp., *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* [4]: 531-538, *6 figs.*

Biberstein, Hans. 1929. Zur Histologie der interdigitalen Mykose, *Arch. Derm. Syphilis* **158**: 386-392.

Biberstein, Hans & Stephan Epstein. 1932. Immunreaktionen bei der menschlichen und tierexperimentellen Oidiomykose der Haut, *Arch. Derm. Syphilis* **165**: 716-742, *6 figs.*

Biberstein, Hans & Selma Grunmandel. 1926. Oidiomykose nach feuchten Umschlägen, *Arch. Derm. Syphilis* **152**: 189-195.

*Bierbaum. 1919. Über die Züchtung des Cryptococcus farciminosus (Rivolta), *Berlin Tierarztl. Woch.*

Bigot, A. & H. Vélu. 1924. Blastomycose des voies lacrymales de l'âne. Anatomie pathologique, *Bull. Soc. Path. Exot.* **17**: 551-553.

—. 1925. Isolement rapide de Cryptococcus Mirandei en culture pure, *Bull. Soc. Path. Exot.* 18: 127-132.

—. 1925. Étude biologique de Cryptococcus Mirandei. agent de la blastomycose des voies lachrymales de l'âne, *Bull. Soc. Path. Exot.* 18: 231-235.

*—. 1925. Contribution à l'étude des blastomycoses animales, *Rev. Path. Comp. Hyg. Gén.* 25: *3 pls.*

Binaghi, Roberto. 1896. Sulla presenza dei blastomiceti negli epiteliomi e sul loro importanza parassitaria, *Policlinico, Sez. Chirurg.* 3: 416-428 [also Über das Vorkommen von Blastomyceten in den Epitheliomen und ihre parasitäre Bedeutung, *Zeitschr. Hyg.* 23: 283-305, *Pl. 4,* 1896].

Birsch-Hirschfeld. 1876. Soorknötchen in pneumonischen Herden der Lungen eines viertägigen Kindes, *Jahresber. Ges. Natur. Heilk.* 1875/6: 31.

Bizzozero, G. 1884. Über die Mikrophyten der normalen Oberhaut des Menschen, *Arch. Path. Anat. Phys.* [Virchow] 98: 441-459, *Pl. 13.*

Blanchard, R., E. Schwartz & J. Binot. 1903. Sur une blastomycose intraperitoneale, *Arch. de Parasitol.* 7: 489-507.

Bloch, Bruno. 1916. Oidiomykose der Haut bei Diabetes, *Kor.-Bl. Schweiz. Ärzte.* 42: 273, 274.

Boggs, T. R. & M. C. Pincoffs. 1915. A case of pulmonary moniliasis in the United States, *Bull. Johns Hopkins Hosp.* 26: 407-410.

Bompard, Leo. 1880. Étiologie du muguet. Observations du muguet de l'oesophage chez l'adulte, *Thèse de Paris* 342: 1-68.

Bonome, Augusto. 1898. Sull'importanza dei blastomiceti nei tumori, *Atti. R. Ist. Veneto.* VII, 9: 793-820, *1 pl.* [56]

Boquet, A. & L. Nègre. 1914. Sur la nature mycosique du parasite de la lymphangite épizootique. Formation de goutelettes d'huile et de filaments, *Bull. Soc. Path. Exot.* 7: 464-466, *1 fig.*

—. 1915. Sur l'évolution du parasite de la lymphangite épizootique chez le cheval, *Bull. Soc. Path. Exot.* 8: 248-250.

—. 1917. Sur la culture du parasite de la lymphangite épizoötique, *Bull. Soc. Path. Exot.* 10: 274-276.

—. 1918. Culture du parasite de la lymphangite épizootique et réproduction expérimentale de la maladie chez le cheval, *C. R. Acad. Sci.* 166: 308-311.

—. 1919. Polymorphisme et déterminisme morphogénique du cryptocoque de Rivolta, *Ann. Inst. Pasteur.* 33: 184-190.

—. 1920. Lymphangite épizootique des solipèdes. Contribution à l'étude des mycoses, *Monogr. Inst. Pasteur.* Paris, Masson et Cie, 143 pp., *3 pls.*

Boquet, A., L. Nègre & G. Roig. 1918. Premiers essais de vaccination préventive contre la lymphangite épizootique, *Bull. Soc. Path. Exot.* 11: 551-553.

Borzi, A. 1889. Bargellinia, nuovo ascomicete dell'orecchia umana, *Malpighia* 2: 469-476.

Borzone, Rodolfo A. 1929. Un caso de blastomicosis en Santa Fé e esayo de revisión de las blastomicosis americanas, *Anal. Soc. Cient. Sta. Fé.* [Argentina] 1: 58-62.

Bourgeois, M. 1915. Über Onychomycosis saccharomycetica, *Derm. Zeitschr.* 22: 411-420.

Bourguignon, G. 1906. Formes microbiennes du champignon du muguet (morphologie et pathologie expérimentale), Imprimerie de la Cour d'Appel, Paris, 220 pp.

Bovaird, D. 1921. A study of tropical sprue or psilosis, *Jour. Am. Med. Ass.* 77: 753-757.

Bowen, John T. & Simeon Burt Wolbach. 1906. A case of blastomycosis: the results of culture and animal experiments, *Jour. Med. Res.* 15: 167-177, *Pls. 16, 17.*

Bowles, F. H. 1912. Coccidiodal granuloma. Report of the nineteenth case in California, *Jour. Am. Med. Ass.* 59: 2253.

Boyd, Mark F. 1920. Is sprue endemic in the South? *Southern Med. Jour.* 13: 229-232.

Boyer, H. C. de & d'Antin. 1881. Note sur un parasite végétal du genre Oidium observé à la surface de quelques affections pustuleuse chez les enfants, *Progrès Méd.* 9: 1025, 1026.

Bra, M. 1898. D'un champignon parasite du cancer, *C. R. Soc. Biol.* 50: 1050-1053.

—. 1899. Le champignon parasite du cancer, *Presse Méd.* 7: 87-90, *9 figs.*

—. 1900. Sur les formations endogènes du champignon isolé des tumeurs cancéreuses, *C. R. Acad. Sci.* 131: 1012-1015, *3 figs.*

Braafladt, Louis H. 1921. Blastomycosis, *China Med. Jour.* 35: 30-35.

Branca, A. & A. Bassetta. 1910. Mycose de l'épithélium lingual developpée au voisinage d'un cancér, *Arch. de Parasitol.* 13: 239-242, *2 figs.*

*Brandenberg. 1893. Angina oidica bei Erwachsenen, *Corresp.-Bl. Schweiz. Ärzte* 23: 809.

Brandweiner, Alfred. 1904. Zur Frage der Blastomykose der Haut und über ihrer Beziehungen zur Folliculitis exulcerans serpiginosa nasi (Kaposi), *Arch. Derm. Syphilis* 71: 49-60, *Pl. 5.*

Brault, J. 1911. Note sur une mycose rencontrée chez un indigène algérien avec culture et préparations histologiques, *Bull. Mém. Soc. Chirurg.* 37: 405-407.

—. 1914. Note àpropos de l'enantiothamnose, *Bull. Soc. Path. Exot.* 7: 90, 91.

Brault, J. & Lucien Masselot. 1911. Étude sur une nouvelle mycose, *Ann. Derm. Syphiligr.* V, 2: 592-602, *7 figs.*

Braxton-Hicks, J. A. & F. R. Chopping. 1924. A case of perionychia due to a Blastomycetes, *Lancet* 206: 128, *2 figs.*

Brayton, A. W. 1902. The immediate diagnosis of blastomycetic dermatitis, *Jour. Amer. Med. Ass.* 38: 312-315.

Brazzola, Floriano. 1896. Contributo allo studio dei Blastomiceti patogeni, *Mem. R. Accad. Sci. Ist. Bologna,* V, 6: 303-310, *1 pl.* [*Sez. Med. Chirurg.* 43-50; also **Boll. Sci. Med. Bologna.*]

Breed, Lorena M. 1912. Some clinical and experimental observations with a saccharomycete, *Arch. Intern. Med.* 10: 108-121, *Figs. 1-6.*

Breinl, A. & Henry Priestley. 1917. Sprue in North Queensland, *Med. Jour. Australia* 1: 95-100.

Brewer, George Emerson & Francis Carter Wood. 1908. Blastomycosis of the spine. Double lesion: two operations: recovery, *Ann. Surgery* 48: 889-896, *Pls. 1-7.*

Bridré, J. & L. Nègre. 1910. Sur la nature du parasite de la lymphangite épizootique, *C. R. Acad. Sci.* 150: 998-1001, 1265-1267.

Bridré, J., L. Nègre & G. Trouette. 1911. Essais de traitement de la lymphangite épizootique par le "606," *Bull. Soc. Path. Exot.* 4: 380-383.

*Brocq-Rousseu, D. 1930. Sur le développement du cryptocoque de la lymphangite épizootique, *Bull. Acad. Vét. France* 3: 150-153.

Brocq-Rousseu, D., Alexandre Guilliermond & L. des Cilleuls. 1927. Étude d'un champignon pathogène du genre Monilia, *Ann. Parasitol. Hum. Comp.* 5: 48-62.

Brouha, M. 1901. Sur les propriétés du sérum des cancéreux au point de vue des anticorps des levures, *Centralbl. Bakt.* I, 30: 945-948.

Broun, G. O., Cecile Jacobson & Onfre Garcia. 1926. Studies on the relation of Monilia to pernicious anemia, *Jour. Clin. Invest.* 2: 607.

Brown, Philip King. 1907. Coccidioidal granuloma, review of 18 cases and reports of cases 15 and 16, *Jour. Am. Med. Ass.* 48: 743-746, *2 figs.*

Brown, Philip King & W. Taylor Cummins. 1915. A differential study of coccidioidal granuloma and blastomycosis, *Arch. Int. Med.* 15: 608-627.

Brünstein, Adèle J. 1907. L'Oidium albicans dans les bouches des personnes saines, *Thèse de Genève.* 151: 48 pp.

Brumpt, Emile & Maurice Langeron. 1934. Considérations sur la piedra de l'Amérique du sud à l'occasion d'un cas provenant du Venezuela, description d'une espèce nouvelle, Piedraia venezuelensis n. sp. *Ann. Parasitol. Hun. Comp.* 12: 134-161, *32 figs., 1 pl.*

Brunetto, Stefania, Raffaele Ciferri & Piero Redaelli. 1934. Caratteri e posizione sistematica del genere Redaellia Cif., *Atti Ist. Bot. R. Univ. Pavia* IV, 5: 125-143, *8 figs.*

Burnier, René & Maurice Langeron. 1922. Épidermite dyshidrosiforme des pieds due à une levure, *Congrès des Dermatologistes et Syphiligr. de la Langue Franç* [Paris, Masson et Cie] 1: 40, 41.

Buscalioni, Luigi. 1896. Il Saccharomyces guttulatus Rob., *Malpighia* **10**: 281-327, *Pl. 7.*

—. 1896. Sul Saccharomyces guttulatus Rob. e sui parassiti del coniglio, *Giorn. R. Accad. Med. Torino.* **59**: 293-297 [IV, 2].

Buschke, Abraham. 1898. Über Hefenmykosen bei Menschen und Thieren, *Samml. Klin. Vortr. N. F. Chirurg.* **64**: 1081-1100 [also cited 218].

—. 1902. Die Blastomykosen nach den bisherigen Erfahrungen und eigenen Untersuchungen dargestellt, *Bibl. Med. Abt. D II Derm. Syphilidol.* **10**: 1-74, *Pls. 1-9.*

—. 1903. Die Blastomykose, Referat, *Arch. Derm. Syphilis* **68**: 415-434.

—. 1909. Ueber die unter der Bezeichnung Hautblastomykose (Dermatitis blastomycetica oidiomycosis der Haut) zusammengefassten Affektionen, *Handb. Hautkrankh.* [Mraček] ed. 2 4: 2: 443-537.

—. 1913. Die Sprosspilze, *Handb. Path. Mikroorganismen* [Kolle u. Wassermann] ed. 2, **5**: 155-210, *2 pls.*

Buschke, Abraham & F. Harry. 1923. Beitrag zur Frage der Sporulationsfähigkeit parasitischer und pathogener Hefen, *Derm. Woch.* **76**: 357-360.

Buschke, Abraham & A. Joseph. 1928 Die Sprosspilze, *Handb. Path. Mikroorganismen* [Kolle u. Wassermann], ed. 3, **5**: 321-400, *1 pl., 32 figs.*

—. 1928. Blastomycose (Ascomycose), *Handb. Haut-u. Geschlechtskr.* [Jadassohn] **11**: 825-925, *66 figs.*

*Buschke, Abraham & Ernst Rosenbaum. 1924. Die Blastomykose mit besonderer Berücksichtigung der Hautaffektionen, *Zentralbl. Haut-Geschlechtskr.* **13**:

Busse, Otto. 1894. Über parasitäre Zelleinschlüsse und ihre Züchtung, *Centralbl. Bakt.* **16**: 175-180, *4 figs.*

—. 1895. Über Saccharomycosis hominis, *Arch. Path. Anat. Phys.* [Virchow] **140**: 23-46, *Pls. 1, 2.*

—. 1896. Experimentelle Untersuchungen über Saccharomycosis, *Arch. Path. Anat. Phys.* [Virchow] **144**: 360-372.

—. 1897. Die Hefen als Krankheitserreger, August Hirschwald, Berlin, 98 pp., *2 pls.*

Cadeddu, Alberto. 1896. Dell'azione degli agenti fisico-chimici sul alcuni blastomiceti patogeni e non patogeni, *Riforma Med.* **12**: 2: 627, 628.

Calmette, Emile. 1893. De la présence d'un microorganisme dans le sang, les crachats et les urines des malades atteints de typhus exanthématique, *Ann. Microgr.* **5**: 85-104, *Pl. 3.*

Camargo, Inah Moraes de. 1934. Agentes etiologicos do Sapinho, estomatite cremosa em São Paulo, *Tese Fac. Med. São Paulo,* 85 pp., *8 pls.*

Campanini, Fausto. 1896. Le resistenza dei blastomiceti agli agenti fisico chimici, *Policlinico, Sez Chirurg.* 3: 272-275.

Canelli, A. F. 1930. Sur l'infection généralisée provoquée par le muguet, ayant caractère embolique, septicémique et mortel, chez un nourisson, *Boll. Soc. Internaz. Microbiol. Sez. Ital.* **2**: 393-396.

Cantón, Eliseo. See Posadas, Alejandro.

Cao, Giuseppe. 1900. Oidien und Oidiomykose, *Zeitschr. Hyg.* 34: 282-339.

Caraven. 1910. Ostéites et ostéo-arthrites mycosiques, *Thèse de Paris,* 120 pp.

Carini, A. 1908. Un caso de blastomycose con localisacão primitiva na mucosa da bocca, *Rev. Soc. Sci. São Paulo* 3: 120-122.

—. 1915. Un cas de blastomycose peritonéale à Coccidioides immitis, *Bull. Soc. Path. Exot.* 8: 712-715, *Pl. 5.*

Carpano, Matteo. 1912. Nota su di uno speciale blastomicete riscontrato nell'apparato respiratorio di un cavallo, *Ann. Ig. Sperim.* 22: 435-450, *Pl. 10.*

Carson, G. R. & W. T. Cummins. 1913. A case of coccidioidal granuloma (California disease), *Jour. Am. Med. Ass.* **61**: 191, 192.

Casagrandi, C. 1925. Sulla etiologia del farcino criptococcico, *Policlinico, Sez. Prat.* 32: 605.

Casagrandi, O. 1896. Sulla riproduzione sperimentale dei corpi inclusi nelle cellule epidermiche dei noduli di mollusco contagioso, *Riforma Med.* 12: 4:473, 474.

—. 1897. Il Saccharomyces ruber (Demne), *Ann. Ig. Sperim.* 7: 535-545.

—. 1897. Sui terreni culturali per la ricerca dei saccaromiceti, *Riforma Med.* 13: 1:163-165.

*—. 1897. [Über die Morphologie der Blastomyceten.] *Atti. Bot. Ist. Univ. Catania.* [Centralbl. Bakt. 23: 563.]

—. 1898. Über das Vorkommen von Blastomyceten in dem Darmkanale gesunder und mit Diarrhoe behafteter Kinder. (Vorläufige Mittheilung) *Centralbl. Bakt.* I, 24: 758, 759.

—. 1898. Su alcune cause della non coltivabilità dei blastomiceti inoculati nell'organismo animale, *Ann. Ig. Sperim.* 8: 306-317.

—. 1898. Sulla diagnosi differenziale dei blastomiceti, *Ann. Ig. Sperim.* 8: 318-353.

—. 1899. Sull'azione patogena dei blastomiceti, *Ann. Ig. Sperim.* 9: 141-155. [Über die pathogene Wirkung der Blastomyceten. (Vorläufige Mittheilung) *Centralbl. Bakt.* I, 24: 759-761.]

Casagrandi, O. & Luigi Buscalioni. 1898. Il Saccharomyces guttulatus (Robin), *Ann. Ig. Sperim.* 8: 229-243, *Pls. 2, 3.*

[Casagrandi, O. & Santori] [see Santori].

Castellani, Aldo. 1905. Tropical forms of pityriasis versicolor, *Brit. Med. Jour.* 2: 1271, 1272, *3 figs.*

—. 1907. Tropical forms of pityriasis versicolor, *Trans. Internat. Derm. Congr.* 6: 658-664, *Pls. 44-47.*

—. 1907. Observations on tropical forms of pityriasis versicolor, *Jour. Trop. Med. Hyg.* 10: 65-67, *1 pl.*

—. 1908. Tropical forms of pityriasis versicolor, *Jour. Cut. Dis.* 26: 393-399.

—. 1910. Observations on tropical broncho-oidiosis, *Brit. Med. Jour.* 2: 868-869.

—. 1910. Tropical bronchomycosis. Observations on a new species of Epidermophyton found in tinea cruris. A new intestinal Spirillum, *Philippine Jour. Sci.* B5: 197-210, *2 pls.*

—. 1911. Observations on fungi of the genus Endomyces affecting man in the tropics, *Centralbl. Bakt.* I, 58: 236-238.

—. 1912. Observations on the fungi found in tropical bronchomycosis, *Lancet* 1: 13-15.

—. 1912. Note on the etiology of some tropical dermatomycoses (tinea cruris, tinea flava et nigra, tinea imbricata), *Proc. R. Soc. Med. Derm. Sect.* 6: 31-39.

—. 1912. Note on the importance of Hyphomycetes and other fungi in tropical pathology, *Brit. Med. Jour.* 2: 1208-1212.

—. 1913. Note on the etiology of some tropical dermatomycoses (tinea cruris, tinea flava et nigra, tinea imbricata), *Brit. Jour. Derm. Syphilis* 25: 23-31.

—. 1913. A note on broncho-oidiosis, *Jour. Trop. Med. Hyg.* 16: 102-104.

—. 1913. Further observations on the fungi of the genus Endomyces found in man, *Arch. de Parasitol.* 16: 184-186, *1 table.*

—. 1914. Notes on the Hyphomycetes found in sprue: with remarks on the classification of fungi of the genus Monilia Gmelin 1791, *Jour. Trop. Med. Hyg.* 17: 305-310.

—. 1916. The plurality of species of the so-called ''thrush fungus'' (champignons du muguet) of temperate climates, *Ann. Inst. Pasteur* 30: 149-154.

—. 1916. A case of vaginitis probably due to Monilia Pinoyi, *Jour. Trop. Med. Hyg.* 19: 89, 90.

—. 1917. Note sur la ''broncho-spirochétose'' et les ''bronchites mycosiques'' affections simulantes quelquefois la tuberculose pulmonaire, *Presse Méd.* 25: 377-380.

—. 1920. The etiology of thrush, *Jour. Trop. Med. Hyg.* 23: 17-22.

—. 1921. The treatment of sprue by massive doses of sodium bicarbonate, *Brit. Med. Jour.* 1: 338, 339.

—. 1924. A new type of blastomycosis cutis (Furunculosis cryptococcica, foliculitis decalvans cryptococcica), *Jour. Trop. Med. Hyg.* 27: 326-328, *2 figs.*

—. 1924. Haemorrhagic bronchites of non-tubercular origin, *Internat. Conf. Health Prob. Trop. Am. United Fruit Co.* 857-907.

—. 1925. Bronchomycosis, *Military Surgeon* 57: 113-133.

—. 1925. Notes on non-gonorrhoeal urethrites, *Jour. Trop. Med. Hyg.* 28: 250-252.

—. 1925. Notes on three new yeast-like organisms and a new bacillus with remarks on the clinical conditions from which they have been isolated: furunculosis blastomycetica, macroglossia blastomycetica, stomatitis cryptococcobacillaris, *Jour. Trop. Med. Hyg.* 28: 217-223.

—. 1926. Bronchomycosis, *Jour. State Med.* 34: 202-216.

—. 1926. Tonsillomycoses, *New Orleans Med. Surg. Jour.* 78: 651-661.

—. 1928. Notes on blastomycosis; its aetiology and clinical varieties, *Proc. R. Soc. Med.* 21: 447-462, *10 figs.*

—. 1928. Considerations on the fungi found in blastomycosis, *Am. Med.* 34: 289-295, *5 figs.* [Reprinted as part of longer paper in *Am. Jour. Trop. Med.* 8: 381-388.]

—. 1928. Blastomycosis and some other conditions due to yeast-like fungi (budding fungi), *Am. Jour. Trop. Med.* 8: 379-422, *19 figs.*

—. 1929. Mannitol agar in the differentiation of fungi of the type of Blastomyces, *Proc. Soc. Exper. Biol. & Med.* 26: 544.

—. 1929. I miceti della blastomicosi nord-Americana, *Ann. Med. Nav. Colon.* 35: 239-245, *2 pls.*

—. 1929. Certain bronchomycoses which may simulate pulmonary tuberculosis, *Jour. Trop. Med. Hyg.* 32: 1-8, 17-22, *14 figs.*

—. 1929. Urethromycoses of the male and vulvovaginomycoses, *Jour. Trop. Med. Hyg.* 32: 357, 358.

—. 1929. A mannitol fermenting Monilia, *Proc. Soc. Exper. Biol. & Med.* 26: 544, 545.

—. 1930. Tonsillomycoses: a brief general account, *Practitioner* [London] 124: 67-81, *11 figs.*

—. 1930. Fungal diseases of the tonsils (Tonsillomycoses), *Jour. Trop. Med. Hyg.* 33: 165-180, *31 figs.*

—. 1930. The fungi found in North American blastomycosis: their plurality of species, *Brit. Jour. Derm. Syphilis* 42: 365-374, *1 pl.*

—. 1931. Minor tropical diseases, *Jour. Trop. Med. Hyg.* 34: 161-164, 206-213, 240-251, 274-276, 364-366, 396, 397.

—. 1932. A new variety of Geotrichum matalense (Geotrichum matalense var. Chapmani), *Jour. Trop. Med. Hyg.* 35: 278, 279, *3 figs.*

—. 1933. Blastomycosis, a short general account, *Med. Press Circ.* 136: 438-443.

—. 1933. The advisability of using in laboratory work sugars tested by microbiological methods, *Jour. Trop. Med. Hyg.* 36: 185, 186.

Castellani, Aldo & Igino Jacono. 1933. Observations on fungi isolated from cases of blastomycosis pulmonalis in North America and Europe. Remarks on blastomycetin, *Jour. Trop. Med. Hyg.* 36: 297-321, *56 figs.*

Castellani, Aldo & G. C. Low. 1913. The rôle played by fungi in sprue, *Jour. Trop. Med. Hyg.* 16: 33-35.

Castellani, Aldo, Mackenzie Douglas & E. T. Thompson. 1921. Notes on certain forms of bronchitis clinically resembling tuberculosis: broncho hemisporosis, bronchomoniliasis, bronchoanaeromycosis, *Jour. Trop. Med. Hyg.* 24: 149-152.

—. 1925. Notes on mixed mycotic infections of the bronchi. The mixed Monilia and Anaeromyces infection, *Jour. Trop. Med. Hyg.* 28: 257-261.

Castellani, Aldo & Frank E. Taylor. 1925. Vaginal Monilias and vaginal moniliases, *Jour. Obstet. & Gyn. Brit. Emp.* 32: 69-78, *Figs. 1-4.*

—. 1925. Further observations on vaginal Monilias and vaginal moniliases, *Jour. Trop. Med. Hyg.* 28: 242, 249.

*Castex, M. R. & Croveri. 1924. Sobre un caso de broncomicosis, *Prensa Méd. Argentina* 9: 321.

Catanei, A. 1925. Présence d'un Monilia sur la langue de singes d'Algérie, *C. R. Soc. Biol.* 93: 92-94.

—. 1925. La langue noire pileuse: sa parasitologie, reflexions sur sa pathogénie, *Arch. Inst. Pasteur Algérie* 3: 379-393.

—. 1925. Sur la pathogénie de la langue noire pileuse, *C. R. Soc. Biol.* 93: 1492-1494.

—. 1932. Les blastomycoses en Afrique du Nord, *Reunión Soc. Argentina Patol. Regional del Norte en Tucumán* 7: 222-226.

—. 1932. Présence de champignons à formes-levures dans cinq types différents de glossite chez l'homme en Algérie, *Reunión Soc. Argentina Patol. Regional del Norte en Tucumán* 7: 233-238.

Cazalbou, L. 1915. Au sujet des travaux de MM. L. Nègre et A. Boquet sur le parasite de la lymphangite épizootique du cheval, *Bull. Soc. Path. Exot.* 8: 89, 90.

Čejka, Bohumil. 1912. Über eine in den Haaren des Menschen parasitisch lebende Hefeart. *Sitzungsber. K. Böhm. Ges. Wiss. Math. Naturw. Kl.* 1911: 30: 1-16, *1 pl.* [mit Klinischen Bemerkungen von F. Šamberger].

Chalmers, Albert J. & J. B. Christopherson. 1914. Murmekiasmosis amphilaphes, *Jour. Trop. Med. Hyg.* 17: 129-135.

Chalmers, Albert J. & Norman MacDonald. 1920. Bronchomoniliasis in the Anglo-Egyptian Sudan and Egypt, *Jour. Trop. Med. Hyg.* 23: 1-7, *1 pl.*

Charrin, A. 1895. L'Oidium albicans, agent pathogène général; mécanisme des accidents, *Semaine Méd.* 15: 247.

Charrin, A. & E. Ostrowsky. 1895. L'Oidium albicans, agent pathogène général. Pathogénie des desordres morbides, *C. R. Acad. Sci.* 120: 1234-1236.

—. 1896. L'Oidium albicans, agent pathogène général, *C. R. Soc. Biol.* 48: 743, 744.

Cheadle, W. B. & Malcolm Morris. 1879. Trichorrhexis nodosa, piedra, tinea nodosa, a contribution to the pathology of certain affections of the hair, *Lancet* 1: 190, 191.

*Chelliah, S. 1918. Rhinosporidium kinealyi, *Jour. Ceylon Branch Brit. Med. Ass.* 2 pp., *1 pl.* [Also reprinted in *Indian Med. Gaz.* 53: 424, 425, 1918; *Jour. Trop. Med. Hyg.* 21: 247, 248, 1918.]

Chevalier, J. 1898. Sur un champignon parasite dans les affections cancéreuses, *C. R. Acad. Sci.* 128: 1293-1296.

—. 1898. Sur un champignon parasite du cancér, *C. R. Acad. Sci.* 128: 1480.

—. 1899. La cancér, maladie parasitaire, *Thèse Méd. Paris* 670: 79 pp.

Chiamenti, Alessandro. 1879. Intorno al parassitismo dell'Oidium lactis ed ai mezzi per prevenirne e combatterne lo sviluppo, *Lo Sperimentale* 43: 326-334.

Chiari, Hermann. 1930. Zur Pathologie und Histologie der generalisierten Torulose (Blastomykose), *Arch. Derm. Syphilis* 162: 422-441.

Chipman, Ernest Dwight & H. J. Templeton. 1930. Coccidioidal granuloma, *Arch. Derm. Syphilol.* 21: 259-275.

Chou, C. H. & F. Reiss. 1931. Coccidioidal endophthalmitis, *Nat. Med. Jour. China* 17: 747-754, *2 pls.*

Christensen, C. & Ludvig Hektoen. 1906. Two cases of generalized blastomycosis, *Jour. Am. Med. Ass.* 47: 247-252.

Christison, James Trent. 1925. A fatal case of thrush involving the skin, lungs and nails, *Am. Jour. Dis. Children* 29: 283.

Chyurlia, N. 1926. Notes on a case of bronchomycosis, *Jour. Trop. Med. Hyg.* 29: 145, 146.

Ciarrocchi, L. 1933. Onicomicosi da Mycotorula, *Giorn. Ital. Derm. Sifilol.* 74: 415-429, *3 pls.*

Ciferri, Raffaele. 1925. Studi sulle Torulopsidaceae. Sui nomi generici di Torula, Eutorula, Torulopsis, Cryptococcus e sui nome di grupo Torulaceae, *Atti Ist. Bot. R. Univ. Pavia.* III, 2: 129-146.

—. 1930. Contribuzioni alla sistematica delle Torulopsidaceae. II-XIV, *Arch. Protistenk.* 71: 405-452.

—. 1931. A new variety of Eutorulopsis dubia Ciferri & Redaelli, *Centralbl. Bakt.* II, 83: 33-37, *3 figs.*

—. 1932. Sulla posizione sistematica del genere Coccidioides e di due genere affini, *Arch. Protistenk.* 78: 238-262, *Pls. 2, 3.*

Ciferri, Raffaele & José D. Alfonseca. 1931. A new variety of Blastodendrion intestinale Mattl., *Centralbl. Bakt.* II, 83: 273-276, *1 pl., 1 fig.*

Ciferri, Raffaele & Bailey K. Askford. 1929. A new species of Blastodendrion, *Porto Rico Jour. Public Health Trop. Med.* 5: 91-105, *Figs. 1-4* [plates].

—. 1930. A new variety of Torulopsis minuta (Saito), Cif. & Red., *Centralbl. Bakt.* II, 81: 60-63, *1 fig.*

Ciferri, Raffaele & Piero Redaelli. 1925. Monografia delle Torulopsidaceae a pigmento rosso, *Atti. Ist. Bot. R. Univ. Pavia.* III, 2: 147-303, *Pls. 4-8.*

—. 1929. Studies on the Torulopsidaceae, a trial general systematic classification of the Asporogenous ferments, *Ann. Myc.* 27: 243-295, *Pls. 4-6.*

—. 1934. Coccidioides immitis et paracoccidioides brasiliensis comme producteurs d'ammoniaque aux dépens des substances organiques azotées, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 6: 126-128.

—. 1934. Phenomènes de conjugaison et d'endosporulation in vitro du Coccidioides immitis Stiles, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 6: 141-145.

—. 1934. De la position systématique du Coccidioides immitis Stiles, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 6: 373-376.

—. 1934. Studii sul Coccidioides immitis Stiles. IV. Caratteristiche culturali, biochimiche, pathogenetiche e micromorfologiche in vivo ed in vitro dei ceppi tipici, *Boll. Soc. Ital. Biol. Sperim.* 9: V. Caratteristiche culturali, biochimiche, patogenetiche e micromorfologiche in vivo ed in vitro dei ceppi degradati, *Ibid.* 9.

—. 1934. Sulla posizione sistematica dell'agente patogeno del farcino equino, *Boll. Ist. Sieroterap. Milanese.*

—. 1934. Sporendonema epizoum (Corda) Cif. et Red., an entity including Hemispora stellata and Oospora d'Agatae, *Jour. Trop. Med. Hyg.* 37: 167-170.

Clark, Esther Bridgman. 1927. Effect of gentian violet and mercurochrome on Endomyces albicans with special reference to the mycelial form, *Jour. Infect. Dis.* 40: 423, 424.

Cleary, J. H. 1904. A case of generalized blastomycosis, *Trans. Chicago Path. Soc.* 6: 105-113.

Cleland, J. B. 1927. A case of systemic blastomycosis with the formation of a myxomatous-looking tumor-like mass, *Med. Jour. Australia* 14: 1: 337-340, *1 fig.*

Clerc, A. & Antoine Sartory. 1908. À l'étude biologique d'une levure isolée en cours d'une angine chronique, *C. R. Soc. Biol.* 64: 135-137.

Cohendy, Frederic. 1899. Sur le traitement du muguet chez le nouveau-né, *Thèse de Paris* 215: 1-44.

Cohn, Erich. 1902. Untersuchungen über eine neue tierpathogene Hefeart (Hefe Klein), *Centralbl. Bakt.* I, 31: 739-748.

—. 1903. Weitere Untersuchungen über die Kleinsche thierpathogene Hefe, *Centralbl. Bakt.* I, 33: 688-696, *2 pls.*

—. 1904. Ein Beitrag zum Vergleich der Kleinschen Hefe mit anderen pathogenen Sprosspilzen, *Centralbl. Bakt.* I, 36: 369-379.

Colard, A. & D. Jaumain. 1925. Sur un cas de Monilia pulmonaire, *Bruxelles Méd.* 5: 1503-1506.

Cole, Warren Henry. 1924. Systemic blastomycosis (oidiomycosis), *Ann. Surg.* 80: 124-134.

Coley, William B. & Martha Tracy. 1907. Report of a case of oidiomycosis, *Jour. Med. Res.* 16: 237-249, *Pls. 18-20.*

Colomb, Armand. 1923. Contribution à l'étude de l'Endomyces albicans, morphologie, cytologie, biologie et pouvoir pathogène, *Thèse Univ. Strasbourg Fac. Pharm.* 14: 1-90.

Colpe, J. 1894. Hefezellen als Krankheitserreger im weiblichen Genitalkanal, *Arch. Gyn.* 47: 635-645.

Concetti, Luigi. 1900. Biologie et pathogénie du muguet, *Arch. Méd. Enf.* 3: 449-479, 517-541, 590-605.

Connor, Charles L. 1928. Monilia from osteomyelitis, *Jour. Infect. Dis.* 43: 108-116.

Connor, I. 1933. Chronic paronychia due to Monilia, *Med. Jour. Australia* 20: 312-314, *2 figs.*

Conor, A. 1912. Sur une levure pathogène, *Arch. Inst. Pasteur Tunis* 1912: 215-218.

Conor, A. & A. Bruch. 1911. Un cas de blastomycose humaine observé en Tunisie, *Bull. Soc. Path. Exot.* 4: 366-368.

Conor, A. & C. Marchetti. 1913. Un nouveau cas de blastomycose observé en Tunisie, *Bull. Soc. Path. Exot.* 6: 556-559.

Cooke, Jean. V. 1915. Immunity tests in coccidioidal granuloma, *Arch. Int. Med.* 15: 479-486.

Cooper, G. W. 1932. Outline of culture character studies of an undescribed species of Cryptococcus, *Am. Jour. Trop. Med.* 12: 97-100.

Copelli, Mario. 1912. Sopra un caso di blastomicosi, *Giorn. Ital. Mal. Ven. Pelle* 46: 467-492, *2 pls.*

Cornbleet, Theodore. 1929. The use of gentian violet in erosio interdigitalis saccharomycetica, *Arch. Derm. Syphilol.* 20: 184, 185.

Corselli, G. & B. Frisco. 1895. Blastomicete patogeno nell'uomo contributo all'etiologia dei tumori maligni, *Ann. Ig. Sperim.* 5: 433-447, *Pls. 12-15.*

—. 1895. Pathogene Blastomyceten beim Menschen. Beiträge zur Aetiologie der bösartigen Geschwülste, *Centralbl. Bakt.* I, 18: 368-373.

Cossery, G. N. 1930. Blastomycetic meningitis, *Jour. Egyptian Med. Ass.* 13: 198-206, *1 pl.*

Costa, Junior, A. F. da. 1929. Granuloma coccidioidico. Ensaio therapeutici pelos saes de ouro, *Brasil Med.* 43: 1400-1402.

*Costa, Mario. 1919. Mycose pulmonar pelo Oidium brasiliense, *Thèse Rio de Janeiro.*

Coupal, James F. 1924. Report of six cases of blastomycosis, *Internat. Clin.* XXXIV, 4: 1-14, *19 figs.*

Cummins, W. T. & J. Sanders. 1916. The pathology, bacteriology and serology of coccidioidal granuloma, with report of two additional cases, *Jour. Med. Res.* 35: 243-257.

Cummins, W. T., Joseph K. Smith & C. H. Halliday. 1929. Coccidioidal granuloma. An epidemiologic survey with a report of 24 additional cases, *Jour. Am. Med. Ass.* 93: 1046-1049.

Curtis, F. 1896. Contribution à l'étude de la saccharomycose humaine, *Ann. Inst. Pasteur* 10: 449-468, *Pls. 4, 5.*

—. 1899. À propos des parasites du cancér, *Presse Méd.* 7: 117, 118.

Daïreuva, Maria P. 1899. Recherches sur le champignon du muguet et son pouvoir pathogène, *Thèse Med. Nancy* 25: 87 pp., *3 pls.*

Damaschino. 1879. Note su un cas de muguet de l'oesophage, observé chez l'adulte, *L'Union Méd.* III, 27: 981-985.

Damm, Helmut. 1930. Hefen und hefeähnliche Pilze im Säuglingsdarm. Beitrag zur Kenntnis der Gärungsmonilien, *Inaug. Diss. Phil. Fak. Chr. Alb. Univ. Kiel.* 45 pp.

Darling, Samuel T. 1906. A protozoön general infection producing pseudotubercles in the lungs and focal necroses in the liver, spleen and lymph nodes, *Jour. Am. Med. Ass.* 46: 1283-1285.

—. 1908. Histoplasmosis; a fatal infectious disease resembling kala-azar found among natives of tropical America, *Arch. Int. Med.* 2: 107-123, *1 pl.*

—. 1909. The morphology of the parasite (Histoplasma capsulatum) and the lesions of histoplasmosis, a fatal disease of tropical America, *Jour. Exp. Med.* 11: 515-531, *Pls. 19-23.*

Darmagnac, Charles & Bartletti. 1914. Mycose des dindonneaux determinée par une levure pathogène, *Bull. Soc. Centr. Méd. Vét.* 68: 157-163, *5 figs.*

Davis, C. N. 1906. A case of blastomycetic dermatitis, *Jour. Cut. Gen. Urin. Dis.* 24: 90.

Davis, David J. 1924. Coccidioidal granuloma with certain serologic and experimental observations, *Arch. Derm. Syphilol.* 9: 577-588.

Dekester, M. & G. Jeaume. 1923. Cas multiples d'une blastomycose des voies lacrymales chez les ânes dans la région de Fez (Maroc), *Bull. Soc. Path. Exot.* 16: 478-480.

Dekker, N. M. Stelling. 1931. Die Hefesammlung des ''Centralbureau voor Schimmelcultures.'' Beiträge zu einer Monographie der Hefearten. I. Die Sporogenen Hefen, *Verhandel. K. Akad. Wetensch. Amsterdam. Afdeel. Natuurk.* 28: 1: 1-547, *illus.*

Delamare, Gabriel. 1919. Recherches sur les monilioses intestinales, *Bull. Soc. Méd. Hôp. Paris* 43: 572-575.

Delamare, Gabriel & C. Gatti. 1928. L'évolution des kystes de la piedra Paraguayenne, *C. R. Acad. Sci.* 186: 1771, 1772.

*—. 1928. *An. Fac. Cien. Med. Asunción* 2: 26.

—. 1928. Sur la piedra du Paraguay, *Bull. Acad. Med.* III, 99: 500-503.

—. 1928. Culture de la Piedra Paraguayenne, *C. R. Soc. Biol.* 99: 1425-1427.

—. 1929. Caractère neoendothrix de la piedra Paraguayenne, *C. R. Soc. Biol.* 100: 122-124.

Delbanco, 1904. Pathogene Hefe in Kultur und Schnitten, *München. Med. Woch.* 51: 179, 180.

Demanche, & Antoine Sartory. 1907. Étude d'une nouvelle levure isolée d'un pus de péritonite par perforation de l'estomac, *C. R. Soc. Biol.* 63: 261, 262.

Demme, R. 1890. Über einen neuen Sprosspilz, der eine Rothfärbung des Käses hervorbringt, *Mitt. Naturf. Ges. Bern.* 1889: ix-xi.

—. 1890. Sur la présence d'une levure rouge dans le lait et dans le fromage et sur la production de catarrhes intestinaux chez des enfants en bas age ayant bu, cru ou mal cuit, du lait infecté par ce microorganisme. Ouvrages publiés à l'occasion du 70e anniversaire de E. Henoch. [abstr. *Ann. Microgr.* 2: 555, 556, 1890? Internal evidence indicates a date of at least 1890 for the publication of this number. The title p. in copy in U. S. D. A. is defective and has been replaced by a typewritten one giving the date as 1889 and so labeled on the back.]

Desenne, E. 1878. Sur la ''piedra'' nouvelle espèce d'affection parasitaire des cheveux, *C. R. Acad. Sci.* 87: 34-36.

Desjardins, Arthur U. 1925. Röntgenotherapy and diathermy in blastomycosis, *Am. Jour. Röntgenol.* 14: 14-16.

Dickson, Ernest C. 1931. The etiology and symptomatology of coccidioidal granuloma, *California Dept. Public Health Special Bull.* 57: 8-16.

Dittmann, O. 1931. Zur Morphologie und Biologie des sog. Schizosaccharomyces hominis Benedek, *Derm. Woch.* 93: 1925-1932.

Dodd, Katharine & Edna H. Tompkins. 1934. A case of histoplasmosis of Darling in an infant, Am. Jour. Trop. Med. 14: 127-137, *illus.*

Dodge, Carroll William. 1929. The higher Plectascales, *Ann. Myc.* 27: 145-184, *Pl. 1, 2.*

Dold, Hermann. 1917. Über die Ätiologie der Spru, *Arch. Schiffs-Tropenhyg.* 21: 1-16.

*—. 1917. The etiology of sprue, *China Med. Jour.* 31: 387.

—. 1917. Bacteriological and experimental researches on etiology of sprue, *Med. Record* 91: 191-193.

—. 1918. Further notes on the microorganisms found in sprue in China, *China Med. Jour.* 32: 35-37.

—. 1919. Weitere Studien über die Ätiologie der Spru, *Arch. Schiffs-Tropenhyg.* 23: 461.

Dorne, Maurice & Cleveland White. 1931. Treatment of superficial infections with the long wave length Röntgen rays (Grenz rays), *Arch. Derm. Syphilol.* 24: 409-416.

Dorrepaal, C. 1930. Über Schizosaccharomyces hominis Benedek, *Centralbl. Bakt.* II, **82**: 11-17, *6 figs.*

Dowling, G. B. 1930. The pathogenicity of Monilia and other yeastlike fungi, *Brit. Jour. Derm. Syphilis.* 42: 562-568.

Draper, A. A. 1924. Production of mycelial forms by Oidium albicans in carrot infusion, *Jour. Infect. Dis.* 34: 631-635.

—. 1925. Production of mycelium by Oidium albicans, *Jour. Infect. Dis.* 36: 484, 485.

Drouin, V. 1896. Sur une nouvelle mycose du cheval, *Rec. Méd. Vét.* VIII, 3: 337-344, *2 figs.*

Duarte, João Galdino. 1927. Mycose pulmonar pelo Oidium brasiliense, *Brasil Med.* **41**: 131-135.

Dubois, Charles. 1910. Étude d'un cas de trichosporie, *Ann. Derm. Syphiligr.* V, **1**: 447-456, *Pl. 1-3.*

Dubois, Paul Richard Joseph. 1923. Les épidermites à levures, *Thèse Méd. Paris* **294**: 1-80.

Dubreuilh, William. 1924. La question des intertrigo-mycoses, *Ann. Derm. Syphiligr.* VI, 5: 65-68.

—. 1927. Sur les lésions interdigitales d'origine mycosique, *Bull. Soc. Franç. Derm. Syphiligr.* 34: 245-247. [Réunion Strasbourg 1-3.]

Dubreuilh, William & P. Joulia. 1921. De l'intertrigo mycosique—une forme nouvelle d'épidermophytie, *Bull. Soc. Franç. Derm. Syphiligr.* 28: 192.

—. 1922. De l'intertrigo mycosique, forme nouvelle d'épidermophytie due à une levure, *Ann. Derm. Syphiligr.* VI, 3: 145-162.

Dübendorfer, Emma. 1904. Ein Fall von Onychomycosis blastomycetica, *Derm. Centralbl.* 7: 290-302, *3 figs.*

Dufougère, W. 1921. Les dermatomycoses de la Guyane française, *Bull. Soc. Path. Exot.* 14: 354-357.

Duval, H. Rubens & Louis Laederich. 1911. Contribution à l'étude des blastomycoses (Saccharomycoses et Atelosaccharomycoses), *Arch. de Parasitol.* 14: 224-318, *3 pls.*

Eberbeck, E. 1926. Aetiologisch-biologische und pathologisch-histologische Untersuchungen über die Lymphangitis epizootica des Pferdes, *Arch. Wiss. Prakt. Tierheilk.* **54**: 1-31, *8 figs.*

Eisendrath, Daniel N. & Oliver S. Ormsby. 1905. A case of systemic blastomycosis with blastomycetes in the sputum, *Jour. Am. Med. Ass.* 45: 1045-1048, *10 figs.*

Eklund, Fr. 1883. Contribution à l'étude de Lepocolla repens, le champignon élementaire du psoriasis, *Ann. Derm. Syphiligr.* II, 4: 197-203.

Elders, C. 1917. Over de darmflora bij Indische spruw, *Nederl. Tijdschr. Geneesk.* **61**^{1}: 1253-1256.

—. 1919. Over Indische spruw, *Nederl. Tijdschr. Geneesk.* 63^{2}: 1683-1690.

—. 1920. Over de proeven van McCarrison in verband met de opvatting, dat spruw een deficientieziekte is, *Nederl. Tijdschr. Geneesk.* 64^{2}: 2189-2196.

Elliot, R. H. & A. C. Ingram. 1912. A case of Rhinosporidium kinealyi of the conjunctiva, *Ophthalmoscope* 10: 428-432, *5 figs.*

Emig, W. H. 1916. The occurrence in nature of certain yeast-like fungi with reference to their possible pathogenicity in the higher animals, *Ann. Missouri Bot. Gard.* **3**: 243-307, *Figs. 1-13.*

Engelhardt, Willy. 1923-1924. Ein Beitrag zur Ätiologie obflächlicher Hautblastomykosen und Hautsoormykosen, *Arch. Derm. Syphilis* **146**: 313-322.

—. 1927. Über Sprosspilzbefunde bei pemphigusartigen Erkrankungen, *Derm. Woch.* **85**: 1337-1348, *6 figs.*

—. 1932. Über die mikroskopische Betrachtung von Pilzkulturen, *Derm. Woch.* **95**: 1546-1548, *2 figs.*

Engelhardt, Willy, et al. 1929. Ekzema seborrhoicum Unna oder Schizosaccharomycosis Benedek. I. [with K. Nicolai.] Die Pathogenität der Benedekschen Spalthefe für die menschliche Haut, *Arch. Derm. Syphilis* 157: 588-591. II. [with H. Schneider.] Über die Züchtungsergebnisse des Schizosaccharomyces hominis, *Ibid.* 157: 592-597. III. [with H. Geissler.] Über immunbiologische Vorgänge bei der Schizosaccharomykose (Spalthefemykose), *Ibid.* 158: 276-289. VI. Über das Vorkommen von Spalthefen im Inhalt von Hautblasen, *Arch. Derm. Syphilis* 166: 85-93, 1932.

Engelhardt, Willy & W. Brackertz. 1926. Über die Soormykose der Nägel, *Derm. Woch.* 82: 153-162.

—. 1926. Allergie und Immunität bei Soorerkrankungen, *Derm. Woch.* 82: 357-364.

Engelhardt, Willy & W. Haupt. 1933. Zur Frage des gehäuften auftretens von Hautinfektionen beim Diabetiker durch Hefen oder hefeähnliche Pilze, *Klin. Woch.* 12: 1805, 1806, *2 figs.*

Engman, Martin F. 1920. A peculiar fungus infection of the skin (Soorpilz?), *Arch. Derm. Syphilol.* 1: 370-374, *4 figs.*

Engman, Martin F. & R. S. Weiss. 1920. Monilia candida infection of the mouth, *Arch. Derm. Syphilol.* 1: 119-123.

Engman, Martin F., Jr. & O. E. Hagenbusch. 1933. Pityrosporon of Malassez, *Arch. Derm. Syphilol.* 28: 855-858.

Epstein, Alois. 1880. Über Soor bei Kindern, *Prager Med. Woch.* 5: 43-45, 61-63, 74-76, 85-87.

*Epstein, Berthold. 1924. Studien zur Soorkrankheit, *Jahrb. Krankh.* 104: 129.

Ernst, Paul. 1894. Über eine Nierenmykose und das gleichzeitige Vorkommen verschiedener Pilzformen bei Diabetes, *Arch. Path. Anat. Phys.* [Virchow] 137: 486-538.

Escomel, Edmundo. 1915. Sur la blastomycose humaine au Pérou et en Bolivie, *Bull. Soc. Path. Exot.* 8: 90-92.

—. 1919. Mycose s'attaquant à des rongeurs à Aréquipa, Pérou, *Bull. Soc. Path. Exot.* 12: 350-352, *Figs. 1, 2.*

—. 1924. Essai sur la parasitologie d'Aréquipa (Pérou), *Bull. Soc. Path. Exot.* 17: 906-925 [mycoses pp. 917-925].

*Etchevarne, C. & Pablo Negroni. 1932. Caso interesante de localización multiple de la Monilia albicans, *Rev. Argentina Dermosifilologia.* 16: 447, *2 figs.*

Etienne, G. & L. Thiriet. 1920. Mycoses pulmonaires, *Rev. Méd. de l'Est* 48: 30-42.

Evans, Newton. 1903. A clinical report of a case of blastomycosis of the skin, from accidental inoculation, *Jour. Am. Med. Ass.* 40: 1772-1775.

—. 1909. Coccidioidal granuloma and blastomycosis of the central nervous system, *Jour. Tenn. State Med. Ass.* 2: 166-174.

—. 1922. Torula infection: report of two cases, *Calif. State Jour. Med.* 20: 383-385.

Fabian, F. W. & Harlow H. Hall. 1933. Yeasts found in fermented maple syrup, *Centralbl. Bakt.* II, 89: 31-47, *7 figs.*

Fabozzi, Salvatore. 1904. Azione dei blastomiceti sull'epitelio trapiantato nelle lamine corneali. Contribuzione all'etiologia e patogenesi dei tumori, *Arch. de Parasitol.* 8: 481-539, *Pl. 3.*

Fabry, J. 1917. Über erosio interdigitalis blastomycetica seu saccharomycetica, *München. Med. Woch.* 64: 1557, 1558.

—. 1918. Weitere Mitteilungen über Erosio interdigitalis blastomycetica, *Derm. Woch.* 66: 321.

—. 1927. Über aneförmige Blastomycosis acutis. Nachtrag zu der Arbeit von Dr. Meckel, *Derm. Woch.* 84: 824-827, *3 figs.*

Facio, A. A. 1925. Broncho-alveolar-moniliasis. *United Fruit Co. Med. Dept. Ann. Rept.* 14: 135, 136 [1926].

Fairley, N. Hamilton & F. Mackie. 1926. A progress report on researches in sprue (1924, 1925), *Indian Jour. Med. Res.* 14: 105-123.

Falchi, Giorgio. 1926. Beitrag zur Kenntnis der Dermatomykosen, *Arch. Derm. Syphilis* 152: 427-461.

Farah, Najib. 1921. La moniliase bronchique en Égypte, *Presse Méd.* 29: 713-716, *1 fig.*

—. 1923. Observations on Castellani's bronchomoniliasis with report of a case with pneumonic outset and a peculiar clinical course, *Jour. Trop. Med. Hyg.* 26: 1-5.

*Farina, S. 1929. Un caso di dermatite papillomatosa blastomicetica del tipo Gilchrist, *Atti Sez. Soc. Ital. Derm. Sif.*

Farnell, Frederick J. & Samuel Starr. 1917. Systemic oidiomycosis; with manifestations in the central nervous system, *Boston Med. Surg. Jour.* 176: 771-773.

Favera, G. B. dalla. 1914. Per la conoscenza della cosidetta blastomicosi cutanea con un osservazione personale di Oidiomicosi (Gilchrist, Buschke) zimonematosi (DeBeurmann et Gougerot), *Giorn. Ital. Mal. Ven. Pelle.* 55: 650-720 [preliminary note same title, *Ibid.* 55: 333-335].

Favre. 1922. Sur une forme vesico-pustuleuse de l'intertrigo mycosique de Dubreuilh, *Congr. Derm. Syphiligr. Langue Franç.* 1: 31-35.

Favre, & Masao Ota. 1923. Note sur une levure cutanée pathogène, *C. R. Soc. Biol.* 88: 222-224.

Ferguson, Arnold S. 1928. Blastomycosis of eye and face secondary to lung infection, *Brit. Med. Jour.* 1: 442, 443, *2 figs.*

Fermi, Claudio & E. Aruch. 1895. Über eine neue Hefeart und über die Natur des sogenannten Cryptococcus farciminosus Rivoltae, *Centralbl. Bakt.* I, 17: 593-600.

—. 1895. Di un altro blastomicete patogeno della natura del cosi detto Cryptococcus farcininosus Rivolta, *Riforma Med.* 11: 2:339-342.

Fineman, Bertha Cecilia. 1921. A study of the thrush parasite, *Jour. Infect. Dis.* 28: 185-200.

Finnerud, Clark W. 1929. Perlèche, a clinical and etiological study of one hundred cases, *Arch. Derm. Syphilol.* 20: 454-483.

Fischer, B. & C. Brebeck. 1894. Zur Morphologie, Biologie und Systematik der Kahmpilze, der Monilia candida Hansen und des Soorerregers. Jena. 52 pp., *2 pls.*

Fischl, Rudolf. 1919. Entwicklung und gegenwärtiger Stand unserer Kentnisse über die Soorkrankheit, *Ergeb. Inn. Med. Kinderheilk.* 16: 107-191.

Fitzpatrick, Randal E. 1934. The life history and parasitism of Taphrina deformans, *Sci. Agr.* 14: 305-326, *2 pls, 10 figs.*

Flarer, F. 1931. Ricerche cliniche e sperimentali sui fattori etiopatogenetici di alcune epidermomicosi, *Arch. Ital. Derm. Sifiligr. Venereol.* 7: 415-478, *11 figs.*

Fleischer, Moyer S. & M. Wachowiak. 1923. The presence of yeast-like bodies in the blood of human beings. A preliminary report, *Am. Jour. Trop. Med.* 3: 59-68.

—. 1925. Monilia as a possible etiologic factor in psoriasis. Preliminary report, *Arch. Derm. Syphilol.* 11: 756-758.

Flu, P. C. & M. M. G. Woensdreght. 1918. Een geval blastomycose van het centralzenuwstelsel, *Meded. Burgerl. Geneesk. Dienst Nederl. Indië* 6: 1-26, *6 figs.*

Fonseca filho, Olympio Oliveira Ribeiro da. 1922. Sobre os agentes das blastomycoses europeas. Cyclo sexuado e posição systematica do levedo de Hudelo, *Brasil Med.* 36: 101, 102.

—. 1927. Reacção do desvio do complemento do granuloma coccidioidico. A sensibilidade do filtrado de cultura do Coccidioides immitis usado como antigeno, *Sciencia Med.* 5: 682, 683. [Complement fixation test in the coccidioidal granuloma, the use of culture filtrates of Coccidioides immitis as antigen, *Ibid.* 5: 683, 684.]

—. 1928. Ensayo de revisión de las blastomicosis sudamericanas, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 4: 469-501, *19 figs.*

—. 1929. Estudo clinico e pathologico do granuloma coccidioidico, *Rev. Med. Cirurg. Brasil* 37: 121-125, *2 pls.*

—. 1930. Besonderes Studium des Coccidioides immitis und des coccidioidischen Granulomas, *Seuchenbekämpfung, Ätiologie, Prophylaxe u. Exp. Therap. Infektionskr. Mensch. Tiere* 7: 237-250.

—. 1930. O genero Trichosporon, trichosporeses ou trichomycoses nodosas, piedra europea, piedra asiatica e piedra americana, *Rev. Med. Cirurg Brasil* 38: 251-261, *5 figs.*

Fonseca filho, Olympio Oliveira Ribeiro da & A. E. de Arêa Leão. 1927. Sobre o granuloma coccidioidal. Formas de evolução nos tecidos, no pus dos ganglios lymphaticos e nas culturas do Coccidioides immitis. Posição systematica do parasito, *Bol. Inst. Brasileiro Sci.* (Rio de Janeiro) 3: 21-24. Also: Sur le granulome coccidioidal. Formes d'évolution du parasite dans les tissus, dans le pus des ganglions lymphatiques et dans les cultures. Position systématique du Coccidioides immitis, *C. R. Soc. Biol.* 98: 619-621.

—. 1927. La déviation du complément dans le granulome coccidioidal. La sensibilité du filtrat de culture de Coccidioides immitis employé comme antigen, *C. R. Soc. Biol.* 97: 1776, 1777.

—. 1927. Réaction cutanée spécifique avec le filtrat de cultures de Coccidioides immitis, *C. R. Soc. Biol.* 97: 1796, 1797.

—. 1927. Diagnostico differencial entre as fórmas brasileiras de blastomycose, *Sciencia Med.* 5: 615-619, *14 figs.* [The differential diagnosis between the Brasilian forms of blastomycosis, *Ibid.* 5: 619-623.]

—. 1928. Sobre os cogumelos da piedra brasileira, *Mem. Inst. Oswaldo Cruz. Suppl.* 4: 124-127, *2 pls.*

—. 1928. Dermatite blastomycosique, *C. R. Soc. Biol.* 98: 622, 623.

—. 1929. Sobre o agente da proteomycose, *Brasil Med.* 43: 667. [*Acad. Nac. Med.* sessão 23 Maio 1929.]

Fontaine, Bryce W., Marcus Haase & Robert H. Mitchell. 1909. Systemic blastomycosis. Report of a case, *Arch. Int. Med.* 4: 101-117, *17 figs.*

Fontoynont, Maurice. 1922. Sur quelques lésions mycosiques observées à Madagascar, *Bull. Mém. Soc. Chirurg.* Paris 48: 439-442.

Fontoynont, Maurice & Humbert Boucher. 1923. Contribution à l'étude des mycoses de Madagascar, *Ann. Derm. Syphiligr.* VI, 4: 209-235, 318-344, *10 figs.*

Fontoynont, Maurice & Pax Salvat. 1922. Lésions mycosiques due à Saccharomyces granulatus observées à Tananarive (Madagascar). Leur guérison par le bleu de methylène, *Bull. Soc. Path. Exot.* 15: 53-59, *1 pl.*

Forbes, J. Graham. 1909. Mycosis of the tongue and nails, *Brit. Jour. Derm. Syphilis* 21: 221-223.

Forgues, Jean Bernard Charles. 1913. Contribution à l'étude des exoascées pathogènes, *Thèse Bordeaux* 87: 1-100.

Foulerton, Alexander G. R. 1900. On the pathogenic action of Blastomycetes, *Jour. Path. Bact.* 6: 37-63, *Pl. 4.*

Franchetti, Augusto. 1912. Sulla dottrina blastomicetica dei tumori, *Lo Sperim.* 66: 191-194.

Frank, Louis J. 1932. Perlèche in adults; report of four cases apparently due to Monilia with experimental observations, *Arch. Derm. Syphilol.* 26: 451-455.

Franke. 1920. Übertragung der Lymphangitis epizootica durch den Deckakt, *Berliner Tierärztl. Woch.* 36: 37, 38.

Freeman, Walter. 1931. Torula infection of the central nervous system, *Jour. f. Psych. Neur.* 43: 236-345, *43 figs.*

Freeman, Walter & Fred D. Weidman. 1923. Cystic blastomycosis of cerebral gray matter caused by Torula histolytica Stoddard and Cutler, *Arch. Neur. Psych.* 9: 589-603.

Frei, Wilhelm. 1921. Eine Soormykose der Nägel bei einer Salvarsan-Dermatitis. (Reaktionen tierischer Immunseren mit Soorpilzen.) Soorähnliche Pilze als Saprophyten auf pathologisch veränderter Haut, *Arch. Derm. Syphilis* 129: 404-433.

Freund. 1923. Sulla piedra nostras, *Giorn. Ital. Mal. Ven. Pelle* 64: 117-124, *6 figs.*

Freund, Helmuth. 1932. Über eine klinisch und etiologisch charakterisierte Form von Perlèche bei Erwachsenen, Interlabialmykose und ihre symptomatische Bedeutung, *Arch. Derm. Syphilis* 164: 614-627, *6 figs.*

Friedreich, N. 1864. Über das konstante Vorkommen von Pilzen bei Diabetischen, *Arch. Path. Anat. Physiol.* [Virchow] 30: 476-478.

Frisch, A. von. 1898. Soor der Harnblase, *Wien. Klin. Woch.* 11: 875-878.

*Froilano de Mello, Indalencio & Armando Ferreira Alvares. 1918. Um caso de blastomicose com abcessos multiplos, *Medicina Moderna.*

Froilano de Mello, Indalencio & Luis Gonzaga Fernandes. 1918. Sobre a frequencia do parasitismo das vias respiratorias humanas por fungos do tipo de leveduras, *Arq. Hig. Pat. Exot.* 6: 61-69.

—. 1918. Ensaio de classificação de fungos pertencentes a classe dos Blastomyces com descrição dum genero e algumas especies novas, *Arq. Hig. Pat. Exot.* 6. 207-316.

Froilano de Mello, Indalencio & Antonio Paes. 1918. Endomyces cruzi n. sp. agente (?) duma endomicose bronquica simulando asma, *Arq. Hig. Pat. Exot.* 6: 51-60.

Froilano de Mello, Indalencio, Antonio Paes & Loreto de Sousa. 1918. Um caso de sacaromicose com abcessos multiplos simulando a escrofulose, *Arq. Hig. Pat. Exot.* 6: 17-40.

*Froilano de Mello, Indalencio & Arnaldo Rodrigues. 1929. Preliminary note on a case of dermatomycosis with multiple verrucose or ulcerated patches, *The Antiseptic* 26: 427-432, *2 pls.* [Sur un cas de blastomycose à placards multiples végétants verruqueux ou pustulo-ulcérés, *Bull. Soc. Path. Exot.* 22: 142-147, *2 figs.*, 1929.]

Frost, Kendal, H. Sutherland-Campbell & O. A. Plunkett. 1929. Monilia of the tongue. Report of an instance with associated skin lesions, *Arch. Derm. Syphilol.* 20: 811-819.

Frothingham, Langdon. 1902. A tumor-like lesion in the lung of a horse caused by a Blastomyces (Torula), *Jour. Med. Res.* 8: 31-43, *Pls. 3, 4* [n.s. 3].

Fujii, S. 1931. Über Pompholyx und pompholyxartige Erkrankungen, *Jap. Jour. Derm. Urol.* 31: 959-983, *15 figs.* [71, 72].

Gaetano, L. de. 1897. Di un blastomicete patogeno, dotato di rapido potere setticemico per le cavie, *Riforma Med.* 13: 3: 590-593.

Galippe, V. 1885. Note sur un champignon développé dans la salive humaine, *Jour. Anat.* 21: 538-553, *Pl. 27.*

Galli-Valerio, Bruno. 1898. Sur une variété d'Oidium albicans Ch. Robin isolée des selles d'un enfant atteint de gastro-entérite chronique, *Arch. de Parasitol.* 1: 572-582.

—. 1899. Nouvelles observations sur une variété d'Oidium albicans Ch. Robin isolée des selles d'un enfant atteint de gastro-entérite chronique, *Arch. de Parasitol.* 2: 270-276.

—. 1905. Notes de parasitologie et de technique parasitologique, *Centralbl. Bakt.* I, 39: 230-247 [6. Sur la présence de blastomycètes dans un cas de Molluscum contagiosum, pp. 235-237].

—. 1909. L'etat actuel de nos connaissances sur l'agent spécifique de la lymphangite epizootique, *Centralbl. Bakt.* I, Ref. 44: 577-582, *1 fig.*

Gaminara, Angel & Juan E. Mackinnon. 1931. Nota previa sobre la existencia en el Uruguay de la tricomicosis llamada "piedra," *Arch. Soc. Biol. Montevideo Suppl. Fasc.* V: 1314-1319.

Gandini, M. 1930. Micosi faringee e tousillari da Cryptococcus uvae Pollacci e Nannizzi, *Atti Ist. Bot. R. Univ. Pavia.* IV, 2: 157-171.

Gans, Oscar & Ernst Gerhard Dresel. 1921. Über die Beziehungen zwischen Blastomykosen und Tuberkulose, *Arch. Derm. Syphilis* 130: 136-156, *1 fig.*

Gardner, S. J. et al. 1904. An unusual infection in the bones of the foot, *California State Jour. Med.* 2: 386, 387.

Garin, Ch. 1911. Le muguet pulmonaire et ses rapports avec la dothiénénterie, *Semaine Méd.* 31: 217, 218.

Garovaglio, Santo. 1872. Sulla scoperta di un discomicete trovato nel cerume dell'orrecchio umano, *R. Ist. Lombardo Sci. Lett. Rendiconti* II, 5: 463-465.

Garr, Charles C. 1925. Systemic blastomycosis, *Surg. Gyn. & Obstet.* 41: 490-492.

Gastou. 1903. Blastomyces et blastomycose, *Ann. Derm. Syphiligr.* IV, 4: 148, 149.

Gastou & Loiselet. 1909. Présence de levures dans deux cas d'onychomycose d'apparence trichophytique, *Bull. Soc. Franç. Derm. Syphiligr.* 20: 139, 140.

Gaumond, E. 1933. Blastomycose généralisée mortelle, *Bull. Soc. Méd. Hôp. Univ. Québec* 1933: 322-330.

Geiger, Arthur. 1910. Beiträge zur Kenntnis der Sprosspilze ohne Sporenbildung, *Centralbl. Bakt.* II, 27: 97-149, *2 pls., 4 figs.* Also *Diss. K. Techn. Hochsch. München.* 52 pp., *2 pls.*

Gentzsch, Walter. 1908. Über pathogene Sprosspilze bei Diabetes, *Inaug. Diss. Med. Fak. Univ. Jena.* 39 pp.

Gilbert, G. Burton. 1922. Report of a few unusual lung infections, *Southwestern Med.* 6: 43-46, *4 pls.*

Gilchrist, T. Caspar. 1896. A case of blastomycetic dermatitis in man, *Johns Hopkins Hosp. Rept.* 1: 269-283, *Pls. 44-50.*

Gilchrist, T. Caspar & William Royal Stokes. 1896. The presence of an Oidium in the tissues of a case of pseudolupus vulgaris, *Bull. Johns Hopkins Hosp.* 7: 129-133, *1 fig.*

—. 1898. A case of pseudolupus vulgaris caused by Blastomyces, *Jour. Exp. Med.* 3: 53-78, *Pls. 4-8.*

Gioelli, Felice. 1930. Valore dei caratteri zimogeni sulla classificazione di alcune forme di miceti, *Atti Ist. Bot R. Univ. Pavia.* IV, 1: 59-71.

Girard. 1922. Trois cas d'urétrite due à l'Oidium albicans, *Jour d'Urol.* 14: 324.

Giulini, P. 1891. Soor der Vulva, *Centralbl. Gyn.* 15: 1049, 1050.

Golliner. 1916. Soor der Vulva, *Deutsch. Med. Woch.* 42: 1550, 1551.

Gomes, José María. 1923. Lymphangite epizoötica, *Brasil Med.* 37: 1: 303, 304. Also **Collectanea Trab. Inst. Butantan* 2: 309.

*—. 1924. Mycose bronchopulmonar. Monilia butantanensis n. sp. *Inst. Butantan.*

Gonzales Martinez, I. 1916. The complement deviation reaction applied to diagnosis of Monilias of the digestive tract, *Am. Jour. Trop. Dis.* 3: 390, 391.

—. 1922. Los metodos de laboratorio en el diagnostico de la diarrea cronica de los paises calidos, *Bol. Ass. Med. Puerto Rico* 16: 51-58.

Goodman, M. H. 1932. Perlèche, a consideration of its etiology and pathology, *Bull. Johns Hopkins Hosp.* 51: 263-277, *9 figs.*

Goto, Kingo. 1915. Über Blastomyceten meningitis, *Mitt. Med. Fak. Univ. Tokyo* 15: 75-101, *Pls. 9, 10.*

Gotti, Alfredo & Floriano Brazzola. 1897. Sopra un caso di blastomicosi nasali in una cavalla, *Mem. R. Accad. Sci. Ist. Bologna* V. 6: 721-754, *Pls. 1, 2* [*Sez. Med. Chirurg.* 257-290].

Gougerot, H. 1911. La question des blastomycoses, *Paris Méd.* I, *Partie Méd.* 1: 459-465.

—. 1920. Mycodermose cutanée due au Mycoderma pulmoneum, *Bull. Soc. Franç. Derm. Syphiligr.* 27: 185, 186.

Gougerot, H. & Caraven. 1909-10. Hémisporose humaine, nouvelle mycose, *Rev. Chirurg.* 40: 896-920, 1909; 41: 66-89, 1910.

Gougerot, H. & J. Duché. 1932. Endomycose ulcéreuse végétante du nez due á Endomyces albicans, *Bull. Soc. Franç. Derm. Syphiligr.* 40: 1624.

Gougerot, H. & Gancéa. 1914. Épidermomycose due á un parasite levuriforme, *Bull. Soc. Franç. Derm. Syphiligr.* 25: 335-339.

Gougerot, H. & Jean Meyer. 1931. Pityriasis versicolor achromiant variété alba, *Bull. Soc. Franç. Derm. Syphiligr.* 38: 46 [case in **Arch. de la Clinique St. Louis* 773, 1929].

Gougerot, H. & Lorenz Monod. 1914. Hémisporose gommeuse (sixième cas d'hémisporose), *Bull. Soc. Franç. Derm. Syphiligr.* 25: 343.

Gouzartchik-Glarner, Mme. V. 1931. Étude biologique d'une souche d'Aspergillus fumigatus, *C. R. Soc. Biol.* 108: 374-376.

Graham, G. S. 1932. Rhinosporidium Seeberi in nasal polyp. The fourth North American case, *Amer. Jour. Clin. Path.* 2: 73-85, *8 figs.*

Grasset, Hector. 1893. Étude d'un champignon pyogène parasite de l'homme, *Arch. Méd. Exp.* 5: 664-678.

—. 1894. Études sur le muguet. Paris: Société d'éditions scientifiques. 43 pp. *2 pls.*

Grassi, A. 1933. Micosi perigenitale da Monilia tropicalis, *Boll. Sez. Region. Soc. Ital. Derm. Sifilogr.* [1]: 268-270.

Graves, M. L. 1922. Systemic blastomycosis, *Am. Jour. Trop. Med.* 2: 123-132, *5 figs.*

Grawitz, Paul. 1877. Beiträge zur systematischen Botanik der pflanzlichen Parasiten mit experimentellen Untersuchungen über die durch sie bedingten Krankheiten, *Arch. Path. Anat. Phys.* [Virchow] 70: 546-598, *Pls. 18, 19.*

—. 1877. Zur Botanik des Soors und der Dermatomycosen, *Deutsch. Zeitschr. Prakt. Med.* 1877: 209-211, 220-223.

—. 1878. Die Stellung des Soorpilzes in der Mykologie der Kahmpilze: Antwort auf die Einwürfe des Herrn Professor M. Reess in Erlangen, *Arch. Path. Anat. Phys.* [Virchow] 73: 147-150.

—. 1880. Über Schimmelvegetation im tierischen Organismus. Experimentelle Untersuchungen, *Arch. Path. Anat. Phys.* [Virchow] 81: 355-376, *Pl. 10.*

—. 1886. Über die Parasiten des Soors, des Favus und Herpes tonsurans, *Arch. Path. Anat. Phys.* [Virchow] 103: 393-412.

*Greco, Nicolas V. 1908. La blastomicosis cutánea, *Argentina Méd.*

Greenbaum, Sigmund S. & Joseph V. Klauder. 1922. Yeast infections of the skin. Report of cases and of studies on the cutaneous yeasts, *Arch. Derm. Syphilol.* 5: 332-344.

Greenfield, J. G. 1924. Blastomycotic infection of the central nervous system, *Med. Sci. Abstr. & Rev.* 10: 267-272.

Griewank, H. & M. Laveau. 1919. Sur un cas de mycétome à grains rouges. Étude clinique et microscopique, *Bull. Soc. Path. Exot.* 12: 478-482.

Grigorakis, Léonidas & G. Péju. 1921. Sur une nouvelle espèce de levure du genre Debaryomyces (D. Matruchoti), *C. R. Soc. Biol.* 85: 459-462, *1 fig.*

—. 1922. Étude de quelques espèces nouvelles de levures isolées de certains exsudats pathologiques de l'homme, *Bull. Soc. Myc. France* 38: 144-154, *Pls. 6, 7.*

—. 1922. Quelques nouvelles espèces du genre Torula, *Bull. Soc. Myc. France* 38: 155-166, *Pls. 8-10.*

Gronow, Adalbert. 1924. Kultur und Infektionsversuche mit dem Cryptococcus farciminosus, *Arch. Wiss. Prakt. Tierheilk.* 51: 601-615. Also **Inaug. Diss. Berlin.*

Grossi, Gino & Paul Balog. 1928. Études cliniques et expérimentales sur le moniliase pulmonaire (Monilia pinoyi), *C. R. Congr. Internat. Méd. Trop. Hyg., Cairo* 2: 499-548.

—. 1929. Clinical and experimental studies on Castellani's pulmonary moniliasis, Jour. Trop. Med. Hyg. 32: 253-262.

Grschebin, Sinowiy N. 1927. Ein Fall von tiefer primärer Blastomykosis der Haut (Busse-Buschke), *Derm. Woch.* 85: 1049-1055, *1 fig.*

—. 1928. Deep primary blastomycosis of the skin, *Urol. Cut. Rev.* 28: 453-457.

Greschebin, Sinowiy N. & L. N. Maschkilleisson. 1926. Beiträge zur Lehre von der pathologische Anatomie der Gilchrist'schen Hautblastomykose, *Derm. Woch.* 82: 780-787, 811-818.

Gruby, David. 1842. Recherches anatomiques sur une plante cryptogame qui constitue le vraie muguet des enfants, *C. R. Acad. Sci.* 14: 634-636.

Grund, Walter. 1925. Beiträge zur Frage der interdigitalen Mykosen nebst einer Übersicht über dem jetztigen Stand der Frage, *Derm. Zeitschr.* 45: 175-180.

Guéguen, Fernand. 1909. Sur Oospora lingualis, n. sp. et Cryptococcus-linguae pilosae Lucet parasites de la langue noire pileuse, *Arch. de Parasitol.* 12: 337-360, *21 figs.*

Guggenheim, Robert. 1923. Über Onychomykosis oidiomycetica, *Arch. Derm. Syphilis* 142: 305-309.

Guiart, Jules. 1911. Les métastases du muguet, *Rev. Méd.* 31: 330-334.

*Guidi. 1896. Mughetto, micologia et metastasi, Firenze.

Guilliermond, Alexandre. 1928. Recherches sur quelques ascomycètes inférieurs isolée de la stigmatomycose des grains de cotonnier. Essai sur la phylogénie des ascomycètes, *Rev. Gén. Bot.* 40: 328-342, 397-414, 474-485, 535-574, 606-624, 689-704, *Pls. 22-33.*

—. 1928. Clef dichotomique pour la détermination des levures, Le François, Paris, 124 pp.

—. 1931. Recherches sur l'homothallisme chez les levures, *Rev. Gén. Bot.* 43: 49-86, *Pls. 1-6.*

Guilliermond, Alexandre & Ch. Lesieur. 1911. Sur une levure nouvelle, isolée de crachats humains au cours d'un cancér secondaire du poumon, *C. R. Soc. Biol.* 70: 952-954.

Guilliermond, Alexandre & Pablo Negroni. 1929. Sur la présence d'une copulation hétérogamique dans le Saccharomyces Marxianus, *C. R. Soc. Biol.* 101: 564-567, *2 figs.*

Guy, W. H. & F. M. Jacobs. 1927. Granuloma coccidioides, *Arch. Derm. Syphilol.* 16: 308-311.

Haan, J. de. 1902. Indische Spruw, *Geneesk. Tijdschr. Nederl. Indië* 42: 311-314.

Haase, Marcus. 1910. Skin manifestations (clinical and histological) in a case of systemic blastomycosis, *Derm. Studien* 20: 518-523, *7 figs.*

Haase, Marcus, E. R. Hall & C. H. Marshall. 1922. Local blastomycosis, report of a case, *Jour. Am. Med. Ass.* 79: 820, 821, *2 figs.*

Haberfeld, W. 1922. Ein besonders in Südamerika vorkommendes malignes Lymphdrüsengranulom mykotisches Ursprungs, *Wien. Klin. Woch.* 35: 786-789.

Hagiwara, S. 1922. Über Blastomicosis cutis, *Jap. Zeitschr. Derm. Urol.* 22: 941-980, *Pls. 19A, 19B* [77, 78].

Hahn, F. V. v. & Hermann Junker. 1928. Colloid biological studies on thrush, *Jahrb. Kinderheilk.* 121: 85-100.

Haler, David H. 1931. Notes on the incidence of yeast-like organisms in chronic paronychia, *Brit. Jour. Derm. Syphilis* 43: 343-351.

—. 1932. Bronchomoniliasis, *Brit. Med. Jour.* 1: 1052, 1053; 2: 122.

—. 1932. Monilia Pinoyi: some further studies in connection with its cultures and chemical reactions, *Brit. Jour. Derm. Syphilis* 44: 435-444.

—. 1933. Monilia infection of the respiratory tract, *Brit. Med. Jour.* 1: 1130.

Hall, George W., Edwin F. Hirsch & Harry Mock. 1928. Torula histolytica meningo-encephalitis, *Arch. Neur. Psych.* 19: 689-694.

Hallam, Rupert. 1928. Fungous infections of the hands and feet, *Brit. Med. Jour.* 1: 835-838, *2 figs.*

Hamburger, Walter W. 1907. A comparative study of four strains of organisms isolated from four cases of general blastomycosis, *Jour. Inf. Dis.* 4: 201-209, *Pls. 5, 6.*

Hamilton, C. M. 1926. Blastomycosis, *Southern Med. Jour.* 19: 431-435, *8 figs.*

Hammack, R. W. & J. M. Lacey, 1924. Coccidioidal granuloma in Southern California, *California West. Med.* 22: 224-226.

*Hanawa, S. 1920. Studien über die auf gesunder und kranker Haut angesiedelten Pilzkeime, *Jap. Zeitschr. Derm. Urol.* 20.

Hannibal, Edna A. & Mark F. Boyd. 1921. The Monilias of the gastrointestinal tract in relationship to sprue, *Am. Jour. Trop. Med.* 1: 165-180.

Hannover, Adolph. 1842. Über Entophyten auf den Schleimhauten des todten und lebenden menschlichen Körpers, *Arch. Anat. Phys.* [Müller] 1842: 282-295, *Pl. 15.*

Hansmann, G. H. 1924. Torula infection in man. Report of a case, *Boston Med. Surg. Jour.* 190: 917-919.

Hansmann, G. H. & J. R. Schenken. 1934. A unique infection in man caused by a new yeast-like organism, a pathogenic member of the genus Sepedonium, *Amer. Jour. Path.* 10: 731-738, *Pls. 158-161.*

Hanson, William L.: 1931. Rhinosporidium, *Ann. Otol. Rhinol. and Laryngol.* 46: 1013-1020.

Harding, D. B. & Charles C. Garr. 1933. Blastomycosis of bone, *Southern Med. Jour.* 26: 315-320.

Harrison, F. C. 1928. A systematic study of some Torulae, *Trans. R. Soc. Canada Biol. Sci.* 22: 187-225, *5 pls.*

Harter, A. 1908. Blastomycose généralisée, *C. R. Soc. Biol.* 64: 241, 242.

—. 1909. De la blastomycose humaine, *Thèse Fac. Med. Nancy* 20: viii + 222 pp., *6 pls.*

Harter, A. & M. Lucien. 1907. Eosinophilie dans un cas de blastomycose humaine généralisée, *C. R. Soc. Biol.* 63: 528-530.

Hartmann, M. & H. J. M. Schoo. 1912. Over blastosporidiose, *Nederl. Tijdschr. Geneesk.* 56: 2: 105-116, *1 pl.*

Hasegawa, Munenori. 1928. Beiträge zur Kenntnis der Oidiomycose der Haut in Japan insbesondere ihrer kausalen Forschung, *Jap. Jour. Derm. Urol.* 28: 1104-1124, *7 figs.* [86, 87].

Hashimoto, T. 1922. Über Blastomycosis cutis, *Jap. Zeitschr. Derm. Urol.* 22: 1-34, *1 pl.* [1, 2].

Haussmann, D. 1870. Die Parasiten der weiblichen Geschlechtsorgane des Menschen und einiger Thiere nebst einem Beiträge zur Entstehung des *Oidium albicans Rob.* A. Hirschwald, Berlin, 144 pp., *3 pls.*

Heaton, Trevor. 1920. The etiology of sprue, *Jour. Med. Res.* 7: 810-839.

Hedge, Harry Malcome. 1928. The use of carbon dioxide snow in treating blastomycosis, *Jour. Am. Med. Ass.* 90: 1367, 1368.

Hegar, Alfred. 1900. Zur Ätiologie der bösartigen Geschwülste, *Beitr. Geburtsh. Gynäk.* 3: 344-366, *Pl. 10.*

Heidsiek. 1910. Nachweis der Soorpilze in Di-verdächtigen Rachenausstrichen. Besonderes Wachstum eines Soorstammes, *Centralbl. Bakt.* I, 54: 108-114, *1 pl.*

Hektoen, Ludvig. 1899. A case of blastomycetic dermatitis of the leg, *Jour. Am. Med. Ass.* 33: 1383-1385, *3 figs.*

—. 1899. The organism in a case of blastomycetic dermatitis, *Jour. Exp. Med.* 4: 261-278, *Pls. 12-15.*

—. 1900. Un nouveau champignon pathogène, *Centralbl. Bakt.* I, 27: 682, 683.

—. 1907. Systemic blastomycosis and coccidioidal granuloma, *Jour. Am. Med. Ass.* 49: 1071-1077.

Hell, F. 1916. Soorerkrankung der hinteren Harnröhre (Urethritis Posterior mycotica) mit Incontinentia urinae, *Derm. Zeitschr.* 23: 640-649.

Heller, Arnold. 1894. Beiträge zur Lehre vom Soor, *Deutsch. Arch. Klin. Med.* 55: 123-140, *Pl. 4.*

Herff, Otto v. 1895. Über Scheidenmykosen Colpitis mycotica acuta, *Samml. Klin. Vortr. Gyn.* 52: 495-514 [also cited 137].

Herxheimer, K. & A. Bürkmann. 1923. Über Blastomycosis cutis, *Arch. Derm. Syphilis* 142: 100-114.

Hesseltine, H. C. 1933. Diabetic or mycotic vulvovaginitis. Preliminary report, *Jour. Amer. Med. Ass.* 100: 177, 178.

Hessler, Robert. 1898. Blastomycetic dermatitis, report of a case, *Indiana Med. Jour.* 17: 48, 49 [also *Jour. Am. Med. Ass.* 32: 760, 1899].

Heubner, O. 1903. Über einen Fall von Soor-Allgemeininfektion, *Deutsch. Med. Woch.* 29: 581-583, 604-606.

Hibler, E. von. 1904. Über einen Fall von Pyämie mit Soorinfektion, *Centralbl. Bakt.* I, 36: 505-519, *1 pl.*

Hiekel, Rudolf. 1906. Beiträge zur Morphologie und Physiologie des Soorerregers (Dematium albicans Laurent-Oidium albicans Robin), *K. Akad. Wiss. Wien, Math. Naturw. Kl. Sitzungsber.* 115: 159-197, *2 pls.*

Hildreth, E. R. & A. C. Sutton. 1914. Oidiomycosis in Porto Rico, *Jour. Amer. Med. Ass.* 63: 2289.

Hines, Lawrence E. 1924. Studies on the identification of Monilia psilosis, *Jour. Infect. Dis.* 34: 529-535.

Hirano, Chushichi. 1930. A study on thrush, *Jap. Jour. Exp. Med.* 8: 495-498.

Hirsch, Edwin F. 1923. Introduction of coccidioidal granuloma into Chicago, *Jour. Amer. Med. Ass.* 81: 375-377, *2 figs.*

Hirsch, Edwin F. & Dorothy D'Andrea. 1927. The specific substance of Coccidioides immitis, *Jour. Infect. Dis.* 40: 634-637.

—. 1927. Sensitization of guinea pigs with broth culture filtrates and with killed mycelium of Coccidioides immitis, *Jour. Infect. Dis.* 40: 638-640.

Hirsch, Edwin F. & Harriet Benson. 1927. Specific skin and testis reactions with culture filtrates of Coccidioides immitis, *Jour. Infect. Dis.* 40: 629-633.

Hirsch, Edwin F. & George H. Coleman. 1929. Acute miliary torulosis of the lungs, *Jour. Amer. Med. Ass.* 92: 437, 438.

*Hlava, J. 1887. Význam microorganismů při variole, *Sborník lékařsky* 2: [12 pp.] [cited in *Centralbl. Bakt.* I, 2: 688, 689, 1887].

Hoffmann, Erich. 1916. Hartnäckige Pilzerkrankungen der Interdigitalräume (interdigitale Dermatomykose) mit familiärer Übertragung, *Deutsch. Med. Woch.* 42: 1579, 1580.

Hoffmann, W. H. 1928. Die Chromoblastomykose in Cuba, *Arch. Schiffs-Tropen-Hyg.* 32: 485-487.

Hoffstadt, Rachel E. & John S. Lingenfelter. 1929. A pulmonary infection caused by Monilia balcanica (Castellani), *Amer. Jour. Trop. Med.* 9: 461-469.

Hoffstadt, Rachel E. & Homer Wheelon. 1932. Persistent infection of the tongue due to Monilia bronchialis, *Arch. Derm. Syphilol.* 26: 40-43.

Hopkins, Joseph Gardner. 1932. Moniliasis and moniliids, *Arch. Derm. Syphilol.* 25: 599-614.

Hopkins, Joseph Gardner & Rhoda W. Benham. 1929. Monilia infections of the hands and feet, *New York State Jour. Med.* 29: 793-800, *4 figs.*

Hornaday, W. A. 1925. Sprue with report of a case, *U. S. Nav. Med. Bull.* 23: 106-111.

Horta, Paulo. 1911. Sobre uma nova forma de piedra, *Mem. Inst. Oswaldo Cruz* 3: 86-107, *Pls. 5, 6.*

Howes, Willard Boyden & Plinn F. Morse. 1921. Report of two cases of Blastomycosis, *Boston Med. Surg. Jour.* 185: 315-317.

Hoz, Eusebio S. de la. 1905. Champignons pathogènes á mycoses du continent américain, *Thèse de Paris* 432: 125 pp.

Hudelo, L., H. Rubens Duval & Louis Laederich. 1906. Étude d'un cas de blastomycose á foyers multiples, *Bull. Mém. Soc. Méd. Hôp.* Paris 23: 723-734.

Hudelo, L. & H. Montlaur. 1914. Épidermomycose eczématoide par parasites du genre des levures, *Bull. Soc. Franç. Derm. Syphiligr.* 25: 403-406.

Hudelo, L., Antoine Sartory & H. Montlaur. 1918. Épidermomycoses eczématoïdes provoquées par une levure du genre Saccharomyces, *Bull. Sci. Pharmacol.* 25: 352-355.

—. 1918. Épidermomycoses eczématoïdes dues à un parasite du genre Saccharomyces, *Bull. Acad. Méd. Paris* 80: 360-362.

—. 1920. Épidermomycose eczématoïde due á un parasite du genre Endomyces, *C. R. Acad. Sci.* 170: 1085-1088.

Hufschmitt, G., Antoine Sartory, R. Sartory & Jacques Meyer. 1931. Un cas de blastomycose cutanée à foyers multiples, *Ann. Derm. Syphiligr.* VII, 2: 850-876, *11 figs.*

Hurley, Thomas D. 1916. A unique lesion of the heart in systemic blastomycosis, *Jour. Med. Res.* 33: 499-502, *1 pl.*

Hyde, James Nevins, Ludvig Hektoen & A. D. Bevan. 1899. A contribution to the study of blastomycetic dermatitis, *Brit. Jour. Derm. Syphilis* 11: 261-276, *Pls. 1-4.*

Ibrahim, J. 1911. Über eine Soormykose der Haut im frühen Säuglingsalter, *Arch. Kinderheilk.* 55: 91-101.

Ingram, A. C. 1910. Rhinosporidum kinealyi in unusual situations, *Lancet* 2: 726.

Irons, E. E. & E. A. Graham. 1906. Generalized blastomycosis. Report of a case with miliary and ulcerative blastomycosis of the lungs; miliary blastomycosis of the spleen; and multiple superficial and deep abscesses, *Jour. Infect. Dis.* 3: 666-682, *6 figs.*

Ives, George. 1932. A case of coccidioidal granuloma, *Weekly Bull. St. Louis Med. Soc.* 26: 290-293.

Jackson, Chevalier. 1926. Blastomycosis of the larynx, *Arch. of Otolaryngol.* 3: 99-107, *1 pl.*

Jackson, Reginald H. 1926. Surgical treatment of certain massive blastomycotic skin lesions, *Amer. Jour. Surg.* 1: 185-187, *6 figs.*

Jacobi, E. 1907. Eine besondere Form der Trichophytie als Folgeerscheinung des permanenten Bades, *Arch. Derm. Syphilis* 84: 289, 300, *Pls. 11, 12.*

Jacobson, H. P. 1927 Granuloma Coccidioides, apparently successfully treated with colloidal copper. Report of two cases, *California West. Med.* 27: 360-364.

—. 1928. Coccidioidal granuloma, *California West. Med.* 29: 392-396.

—. 1928. Coccidioidal granuloma; specific allergic cutaneous reaction; experimental and clinical investigations, *Arch. Derm. Syphilol.* 18: 562-567.

—. 1930. Coccidioidal granuloma: a clinical and experimental review with [13] case reports, *Arch. Derm. Syphilol.* 21: 790-814, *12 figs.*

Jacono, I. 1920. Notes on some cases of Castellani's bronchomoniliasis, *Jour. Trop. Med. Hyg.* 23: 250-252, *2 figs.*

—. 1926. Reazioni immunitarie delle monilie, *Riforma Med.* 42: 1061.

—. 1930. Contributo alla conoscenza della biologia di taluni blastomiceti, *Morgagni* 72: 683-696.

—. 1930. Contributo allo studio della biologia di taluni blastomiceti (blastomicosi sperimentale), *Riforma Med.* 46: 590-605, *Figs. 1-14.*

Jannin, Louis. 1913. Données nouvelles sur la localisation du Mycoderma pulmoneum, *Rev. Méd. de l'Est.* 45: 170-177.

—. 1913. Les "Mycoderma," leur rôle en pathologie, *Thèse de Nancy* 1001: 278 pp., *4 pls.*

Jannin, Louis, & P. Vernier. 1913. À propos des genres Zymonema et Mycoderma, *C. R. Soc. Biol.* 74: 1133, 1134.

Jaumain, D. & A. Colard. 1925. Sur les caractères d'un champignon du genre Monilia isolé dans un cas mortel de mycose pulmonaire, contracté au Congo Belge, *C. R. Soc. Biol.* 93: 858-860.

*Jeaume, G. 1926. Blastomycose des voies lachrymales de l'âne au Maroc, *Thèse Doct. Vét. Avignon.*

Jeaume, G. & M. Dekester. 1925. Isolement de l'agent pathogène de la blastomycose des voies lachrymales, *Bull. Soc. Path. Exot.* 18: 125-127.

Jessner, Max & Siegmund Kleiner. 1925. Über das Vorkommen von Sprosspilzen an normalen Nägeln und ihre Pathogenität, *Arch. Derm. Syphilis* 149: 363-369.

Joekes, Th. & R. H. Simpson. 1923. Bronchomoniliasis, *Lancet* 2: 108.

Joest, E. 1921. Über Blastomykose der Nasenschleimhaut des Pferdes, *Zeitschr. Infektionskr. Parasitenkr. Hyg. Haustiere* 22: 1-12, *6 figs.*

Johnson, Gertrude & F. T. Breidigain. 1925. Tropical sprue in a child six years of age with isolation of Monilia from patient and tissues of inoculated animal, *Am. Jour. Med. Sci.* 170: 364-371, *4 figs.*

Jones, E. Lloyd. 1927. Torula infection of the naso-pharynx, *Southern Med. Jour.* 20: 120-125, *4 figs.*

Joyet-Lavergne, Ph. 1934. Sur la sexualisation cytoplasmique chez les levures à conjugaison hétérogamique, *C. R. Acad. Sci.* 198: 1071-1073.

Juhel-Renoy, Ed. 1888. De la trichomycose nodulaire, *Ann. Derm. Syphiligr.* II, 9: 777-785, *Pl. 9.*

Juhel-Renoy, Ed. & G. Lion. 1890. Recherches histobiologiques et étiologiques sur la trichomycose nodulaire, *Ann. Derm. Syphiligr.* III, 1: 765-772, *2 pls.*

Junker, H. & M. Wieben. 1928. Weitere Ergebnisse über die Wirkung extremer Potenzverdünnung auf Organismen. II. Versuche mit Pilzen. Die Myzelbildung von Soor, *Planta Zeitschr. Wiss. Bot.* 6: 473-481.

Kadisch, E. 1930. Die Hitzresistenz einiger Hefen, *Derm. Zeitschr.* 60: 48-51.

—. 1930. Untersuchungen über die Schizosaccharomyces hominis sp. nov. Benedek, *Acta Dermato-venereol.* 11: 38-52.

Kämper, Paul. 1924. Die Lymphangitis epizootica des Pferdes, *Arch. Wiss. Prakt. Tierheilk.* 51: 616-641. [Also *Inaug. Diss. Tierärztl. Hochschule Berlin.*]

Kahane, M. 1895. Présence d'une levure dans les cancers, *Semaine Méd.* 15: 127.

*Kambayashi, T. 1923. Über die Erreger der Piedrakrankheit in Japan, *Jap. Jour. Derm. Urol.* 23.

—. 1932. Eine botanische Untersuchung des Microsporon furfur Robin, *Bot. Mag.* (Tokyo) 46: 232-238, *Pls. 4-6.*

Kartulis, S. 1909. Über Blastomykosis glutealis fistulosa, *Zeitschr. Hyg.* 64: 285-304, *Pls. 8, 9.*

Kater, J. McA. 1928. Note on the structure of a Monilia isolated from a case of psoriasis, *Univ. California Publ. Bot.* 14: 301-306, *1 pl., 1 fig.*

Kaufmann-Wolff, Marie. 1915. Zur Klassifizierung einiger Dermatomykosen, *Derm. Zeitschr.* 22: 441-463.

Kawatsure, Shûji. Tierexperimentelle Untersuchungen über die Erreger von sogenannten amerikanischen Blastomykosen: Scopulariopsis americana, Aleurisma tulanense und Coccidioides immitis, *Arch. Derm. Syphilis* 169: 173-199, *11 figs.*

Keating, P. M. 1932. Fungus infection of bone and joint, *Southern Med. Jour.* 25: 1072-1078.

Kehrer, F. A. 1883. Über den Soorpilz, eine medizinische botanische Studie. C. Winter, Heidelberg. 71 pp.

Keil, Ernst. 1929. Zur Klinik der Spalthefemykose, *Derm. Woch.* 88: 427-432.

Keil, Paul. 1921. Die Ausbreitung und Bekämpfung der Lymphangitis epizootica während und nach dem Kriege, *Inaug. Diss. Tierärztl. Hochschule Hannover,* 6 pp.

Keller, Ph. 1927. Zur Klinik der Hyphomykosen insbesondere der dyshidrosiformen Epidermophytien. Zugleich ein Beitrag zur regionären Verbreitung der Hyphomyzeten: Die Pilzflora Oberbadens, *Derm. Zeitschr.* 49: 33-51.

Kesten, Beatrice M., Bailey K. Ashford, Rhoda W. Benham, C. W. Emmons, & M. C. Moss. 1932. Fungus infections of the skin and its appendages occurring in Porto Rico. A clinical and mycologic study, *Arch. Derm. Syphilol.* 25: 1046-1057, *5 figs.*

Khouri, J. 1932. Sur une Monilia isolée des crachats d'un malade atteint de blastomycose pulmonaire: Monilia aegyptiaca, *C. R. Soc. Biol.* 111: 419, 420.

—. 1933. Caractères morphologiques et biochimiques d'une Monilia isolée des crachats d'un malade atteint de blastomycose pulmonaire, *Bull. Soc. Path. Exot.* 26: 7-9.

Kinealy, F. 1903. Localised psorospermosis of the mucous membrane of the septum nasi, *Proc. Laryngol. Soc. London* 10: 109-112; also 11: 43, 44, *1 pl.*, 1904.

Kingergy, Lyle B. & Clinton H. Thienes. 1925. Mycotic paronychia and dermatitis, a hitherto undescribed condition apparently peculiar to fruit canners, *Arch. Derm. Syphilol.* 11: 186-202.

Kirch, Eugen & Ernst Stahnke. 1923. Pathologisch-anatomische und tierexperimentelle Untersuchungen über die Bedeutung des Soorpilzes für das chronische Magengeschwür, *Mittheil. Grenzgeb. Med. Chir.* 36: 174-200.

Kirkpatrick, H. 1916. Rhinosporidium of the lacrimal sac, *Ophthalmoscope* 14: 477-479, *1 fig.*

*Kishimoto, Yutaka. 1921. Über Pityriasis rotunda Matsuura, *Jap. Zeitschr. Derm. Urol.* 21: 26.

Klamann, 1898. Ein Fall von ekzematöser circumscripter Dermatitis mit berücksichtigung der dabei beobachteten Pilzelemente, *Monatsh. Prakt. Derm.* 27: 329-332, *Pls. 4.*

Klarfeld, B. 1920. Zur Histopathologie der experimentellen Blastomykose des Gehirns, *Zeitschr. Ges. Neurol. Psychiatr.* 58: 176-215, *4 pls., 21 figs.*

Klausner, E. 1924. Über ein noch nicht beobachtete Infektion der Schleimhaut des Urogenitalsystem (durch Hefepilze?): Urethritis, Cystitis, Vesiculitis haemorrhagica, *Derm. Woch.* 78: 342, 343, *1 fig.*

Klein, Erich. 1901. Pathogenic microbes in milk, *Jour. Hyg.* 1: 78-95.

Klein, Erich & Mervyn Gordon. 1904. Über die Herkunft einer Rosahefe, *Centralbl. Bakt.* I, 35: 138, 139.

*Kleiner, Siegmund. 1925. Über das Vorkommen von saprophytierenden Sprosspilzen an normalen Nägeln, *Diss. Breslau.*

Klemperer, G. 1885. Über die Natur des Soorpilzes, *Centralbl. Klin. Med.* 6: 849-851.

*—. 1886. Über den Soorpilz. *Thesis Berlin.*

Klopstock, Elizabeth, 1925. Oidiomykosis pustulosa miliaris disseminata corporis et unguium, *Arch. Derm. Syphilis* 149: 477-485, *2 figs.*

Klosterklemper, Hainrich. 1895. Beiträge zur Kenntnis der Lungenmykose der Säugethiere. *Inaug. Diss. Giessen*, 42 pp.

Kohlbrugge, J. H. F. 1901. Die Ätiologie der Apthae tropicae, *Arch. Schiffs u. Trop. Hyg.* 5: 394-397.

—. 1901. Een Bijdrage tot de aetiologie der Indische spruw (psilosis), *Nederl. Tijdschr. Geneesk.* 37^2: 881-890.

Koomaya, Ginji & Ernst Rosenbaum. 1923. Über die Pathogenität alter Hefekulturen, *Derm. Woch.* 77: 1198-1201.

Kotkis, A. J., M. Wachowiak & Moyer S. Fleischer. 1926. The relations of Monilia to infections of the upper air passages, *Arch. Int. Med.* 38: 217-221.

Kovatcheva, Kalina. 1900. Blastomycètes et tumeurs, *Thèse Méd. Nancy* 48: 150 pp.

Kraus, Alfred. 1913. Über das Wesen des sogenaunten Unnaschen Flaschenbazillus, *Arch. Derm. Syphilis* 116: 723-736, *Pls. 35, 36.*

*Kraus, L. 1926. Neue Gesichtspunkte zur Myzelbildung des Soor und ihre Beziehung zur Therapie, *Inaug. Diss. Hamburg.*

Krauspe, Carl. 1927. Untersuchungen zur Biologie des Soorpilzes und zur Pathogenese der Soorkrankheit, *Krankh. Forsch.* 4: 139-163, *14 figs.*

Krauss, William. 1921. Studies of Monilia in connection with sprue, *Am. Jour. Trop. Med.* 1: 119-126.

Krost, R. A., M. J. Moes & A. M. Stober. 1908. A case of systemic blastomycosis, *Jour. Am. Med. Ass.* 50: 184-186.

Kumer, Leo. 1921. Ueber die Wasserbettmykose, *Arch. Derm. Syphilis* 136: 12-21.

—. 1925. Ein Beitrag zur Lokalisation der Soormycose in der Axilla, *Arch. Derm. Syphilis* 148: 399-401, *1 fig.*

—. 1926. Über Pilzerkrankungen der Haut, *Wien. Med. Woch.* 76: 1298-1302.

Kurotchkin, Timothy J. & C. K. Chu. 1929. Bronchomoniliasis. Serological studies on a case, *Nat. Med. Jour. China* 15: 403-409.

Kurotchkin, Timothy J. & C. E. Lim. 1930. The effect of animal passage upon pathogenic Monilia [tropicalis], *Nat. Med. Jour. China* 16: 332-337, *Pl. 1.*

Kurup, P. K. 1931. Rhinosporidium Kinealyi infection, *Indian Med. Gaz.* 66: 239-241, *4 figs.*

Laederich, Louis & H. Rubens Duval. 1909. La mycose de Gilchrist, blastomycose ou oidiomycose des Américains, *Rev. Méd.* 29: 673bis-690bis, 721bis-731bis.

Landau, Theodor. 1899. Die Behandlung des weissen Flusses mit Hefekulturen—eine lokal-antagonistische Bacteriotherapie, *Deutsch. Med. Woch.* 25: 171-173.

Landrieu, Marcel. 1912. Les mycoses oculaires, *Thèse de Paris,* 136 pp.

Lang, Eduard. 1879. Vorläufige Mitteilung von einem neuen Untersuchungsergebnisse bei Psoriasis, *Viertelj. Derm. Syph.* 6: 257-263 [Neue Folge des Archives Derm. Syphilis 11].

Lang, Michael. 1923. Beitrag zur Klinik der Soormykose der Haut, *Derm. Woch.* 76: 429-433.

*Lange. 1921. Über die Züchtung des Cryptococcus farciminosus Rivolta, *Deutsch. Tierärztl. Woch.*

Langenbeck, B. 1839. Auffindung von Pilze auf der Schleimhaut der Speiseröhre einer Typhus Leiche, *Neue Notizen aus dem Gebiete der Natur- und Heilkunde* [Froriep] 12: 145-147.

Langer, Erich. 1921. Über den Soor des Kehlkopfes, *Arch. Laryngol.* 34: 159-163.

Langerhans, Robert. 1887. Ein Fall von Soor des Oesophagus mit eitriger Entzündung der Schleimhaut, *Arch. Path. Anat. Phys.* [Virchow] 109: 352-357.

Langeron, Maurice. 1929. Les astérinées parasites de l'homme. La piedra, *Ann. Parasitol. Hum. Comp.* 7: 309-324.

Langeron, Maurice & Rudolfo V. Talice. 1932. Nouvelles méthodes d'étude et essai de classification des champignons levuriformes, *Ann. Parasitol. Hum. Comp.* 10: 1-80, *5 pls.*

Lantieri, Giovanni. 1931. Dermatomicosi della mano d., con linfangite a rosario dell'avambraccio corrispondente de Oospora d'Agatae, *Arch. Ital. Derm. Sifiligr. Venereol.* 7: 387-396, *1 fig.*

*Lasseur, Ph. & Martin. 1928. *Trav. Lab. Microbiol. Fac. Pharm. Nancy* 1: 142.

Lasseur, Ph. & Ch. Servet. 1922. Étude morphologique et biologique de quelques agents de blastomycoses pulmonaires (Saccharomyces Etiennei, Monilia de Forgues, Sacharomyces Lemonnieri, Monilia Pinoyi, Cryptococcus Neveuxii nov. sp.), *Rev. Méd. de l'Est.* 50: 347-364.

*Laurent, Emile. 1890. Observations sur le champignon du muguet, *Bull. Soc. Belge. Microscopie.* 16: 14.

Leberle, Hans. 1909. Beiträge zur Kenntnis der Gattung Mycoderma, *Diss. K. Techn. Hochsch. München,* 106 pp., *2 pls.*

LeCount, E. R. & J. Meyers. 1907. Systemic blastomycosis, final report of a case described by Eisendrath & Ormsby in 1905. [*Illinois Med. Jour.* 8: 454, 1905; *Jour. Am. Med. Ass.* 45: 1045, 1905.] *Jour. Inf. Dis.* 4: 187-200, *10 figs.*

LeDantec, A. 1908. Présence d'une levure dans le sprue. Sa signification pathogénique, *C. R. Soc. Biol.* 64: 1066-1068.

—. 1913. Note sur un mycoderme rencontré dans les fèces de deux matelots béribériques, *C. R. Soc. Biol.* 74: 412, 413. Also: *Gaz. Hebdom. Sci. Méd. Bordeaux* 34: 83.

—. 1913. Mycodermose intestinale dans divers ètats pathologiques, *C. R. Soc. Biol.* 74: 414, 415.

Legay, E. & P. Legrain. 1893. Tuberculose pulmonaire et muguet, *Arch. Gén. Méd.* 172: 339-342.

Leopold, G. 1900. Untersuchungen zur Ätiologie des Carcinoms und über die pathogenen Blastomyceten, *Arch. Gyn.* 61: 77-120, *Pls. 1-6.*

Levy, Fritz. 1916. Soorangina, *Berlin. Klin. Woch.* 53: 1129.

Lichtenstein, Stephanie. 1914. Über die Differenzierung einzelner Hefearten mit Hilfe spezifischer Agglutinine, *Berlin. Klin. Woch.* 51: 1836, 1837.

—. 1914. Über die Differenzierung einzelner Hefearten mit Hilfe spezifischer Agglutinine, *Arch. f. Physiol.* 1914: 525-532. [*Arch. Anat. Physiol., Physiol. Abt.*]

Lieberthal. 1925. Erosio interdigitalis saccharomycetica, *Arch. Derm. Syphilol.* **12**: 429.

Lim, C. E. & Timothy J. Kurotchkin. 1930. Action of dyes and drugs on Monilia tropicalis, *Nat. Med. Jour. China* **16**: 215-223.

—. 1930. A study on the serological relationship among yeast-like fungi, *Nat. Med. Jour. China* **16**: 338-346.

Lim, C. E., Timothy J. Kurotchkin & C. J. Wu. 1930. Experimental bronchomoniliasis in rabbit, *Nat. Med. Jour. China* **16**: 537-544, *1 pl.*

Lincoln, Mary C. & Stella M. Gardner. 1929. A case of Rhinosporidium in a resident of the United States, *Arch. Path.* **8**: 38-45, *7 figs.*

Linden, A. van den. 1926. Sur L'action pathogène du Monilia albicans, *C. R. Soc. Biol.* **95**: 881-883.

Lindenberg, Adolpho. 1909. Dermatomycoses brasilieras, *Brasil Med.* **23**: 341-345, *2 figs.*

Lindner, P. & P. Knuth. 1916. Untersuchungen über einen in Eiter eines an der epizootischen lymphangites erkrankten Maultieres gefundenen Pilz (Monilia capsulata), *Zeitschr. Infek. Krankh. Hausthiere* **17**: 290-308, *Pls. 11-14, 2 figs.*

*Lindqvist, C. A. 1895. Epizootisk lymfangit hos häst, *Tidskr. Veter. Med. Husjursskötsel.* **14**: 224.

Linossier, Georges, 1916. Sur la biologie de l'Oidium lactis, *C. R. Soc. Biol.* **79**: 348-352.

—. 1916. Contribution à l'étude des mycoses bronchopulmonaires. Étude biologique d'un Oidium lactis parasite de l'homme, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **40**: 575, 585.

—. 1917. Sur la biologie de l'Oidium lactis. L'Oidium lactis parasite, est-il identique à l'Oidium lactis saprophyte, *C. R. Soc. Biol.* **80**: 283-286.

—. 1917. Contribution à l'étude des mycoses bronchopulmonaires, oidiomycose, *Bull. Mém. Soc. Méd. Hôp. Paris.* III, **41**: 535-538.

Linossier, Georges & Gabriel Roux. 1890. Sur la morphologie et la biologie du champignon du muguet, *Ann. Micrographie* **2**: 434-437.

—. 1890. Recherches biologiques sur le champignon du muguet, *Arch. Méd. Exp.* **2**: 222-252 [see also Ibid. 2: 62-87].

—. 1890. Sur la nutrition du champignon du muguet, *C. R. Acad. Sci.* **110**: 355-358.

—. 1890. Sur la fermentation alcoolique et la transformation de l'alcool en aldéhyde provoquées par le champignon du muguet, *C. R. Acad. Sci.* **110**: 868-870.

—. 1891. Sur la fermentation alcoolique et la transformation de l'alcool en aldéhyde provoquées par le champignon du muguet, *Ann. Micrographie* **3**: 322-332.

Littauer, Arthur. 1923. Zur Therapie des Pruritus vulvae mit besonderer Berücksichtigung von Soor und Trichomonas, *Zentralbl. Gyn.* **47**: 25-33.

Lodder, Jacomina. 1934. Die Anaskosporogenen Hefen **1**: 1-256, *114* figs. [Proefschrift Univ. Utrecht, also issued as Die Hefesammlung des Centraalbureau voor Schimmelcultures, Beiträge zu einer Monographie der Hefearten 2.]

Löwenbach, Georg & Moriz Oppenheim. 1904. Beitrag zur Kenntnis der Hautblastomykose, *Arch. Derm. Syphilis* **69**: 121-144, *Pls. 13-15.*

Lombardo, C. 1921. Per la conoscenza della endomicosi cutanea, *Giorn. Ital. Mal. Ven. Pelle* **62**: 243-265.

—. 1922. Dermatite endomicetica interdigitale, *Giorn. Ital. Mal. Ven. Pelle* **63**: 674-693, *1 pl.*

—. 1923. Nuove osservazioni di endomicosi cutanea, *Giorn. Ital. Mal. Ven. Pelle* **64**: 563-573, *1 pl.*

—. 1925. Del dermatomicosi da Endo- o Saccaromices albicans, *Giorn. Ital. Derm. Sifilol.* **66**: 649, 650.

Long, Esmond R. 1926. Specific necrosis in the infectious granulomas, demonstration in the testis in experimental tuberculosis, *Bacillus abortus* infection and blastomycosis, *Jour. Am. Med. Ass.* **87**: 1441-1445, *4 figs.*

Low, G. Carmichael. 1928. Sprue, an analytical study of 150 cases, *Quarterly Jour. Med.* 21: 523-534.

Lucet, Adrien. 1901. Contribution à l'étude étiologique et pathogénique de la langue noire pileuse, *Arch. de Parasitol.* 4: 262-289.

*Lührs. 1922. Einige Beiträge zur Züchtung des Cryptococcus farciminosus, *Zeitschr. Veterinärkunde.* 361.

Lundsgaard, K. K. K. 1900. Ein Fall von Hypopyonkeratitis, *Klin. Monatsh. Augenheilk.* 38: 13-19.

*Lutz, A. 1908. Uma mycose pseudo-coccidica localizada na bocca, Contribuição ao estudo das hyphoblastomycoses americanas, *Brasil Med.*

Lynch, Frank B. Jr. & Edward Rose. 1926. Torula meningitis. Report of an additional case, Ann. Clin. Med. 4: 755-760.

MacBryde, Cyril M. & Ewell Thompson, 1933. See [Moore, Morris] MacBryde, etc.

MacCormac, H. 1927. Paronychia due to Oospora (Oidium) albicans, *Brit. Jour. Derm. Syphilis* 39: 394-398, *1 pl., 1 fig.*

Macfie, J. W. Scott. 1921. Note on some fungal infections in West Africa, *Ann. Trop. Med. Parasitol.* 15: 271-282.

Macfie, J. W. Scott & A. Ingram. 1921. Bronchomoniliasis complicating pulmonary tuberculosis in a native of the Gold Coast, West Africa, *Ann. Trop. Med. Parasitol.* 15: 53-58.

McGehee, J. L. & I. D. Michelson. 1926. Torula infection in man, *Surg. Gyn. Obstet.* 42: 803-808, *6 figs.*

Mackie, F. P. & G. D. Chitre. 1928. Yeasts and sprue, *Indian Med. Res. Mem.* 11: 1-39, *8 pls., 8 tables.*

McKendree, Charles A. & Leon H. Cornwall. 1926. Meningo-encephalitis due to Torula, *Arch. Neurol. Psych.* 16: 167-181, *9 figs.*

McKinney, Margaret J. 1929. Yeast-like organisms of human origin, *Jour. Infect. Dis.* 44: 47-55.

Macleod, J. M. H. 1930. Skin diseases due to Monilia and other yeast-like fungi, *Brit. Jour. Derm. Syphilis* 42: 549-561, *8 figs.*

—. 1930. Some skin affections due to yeast-like fungi, *Brit. Med. Jour.* 1: 1119-1123.

Macleod, J. M. H. & G. B. Dowling. 1928. An experimental study of the Pityrosporon of Malassez; its morphology, cultivation and pathogenicity, *Brit. Jour. Derm. Syphilis* 40: 139-148, *1 pl., 3 figs.*

MacNeal, W. J. & C. E. Hjelm. 1913. Note on a mold, Coccidioides immitis, found in a case of generalized infection in man, *Jour. Am. Med. Ass.* 61: 2044.

MacNeal, W. J. & R. M. Taylor. 1914. Coccidioides immitis and coccidioidal granuloma, *Jour. Med. Res.* 30: 261-274, *Pls. 27-30.*

Macé, O. 1903. Le muguet à forme levure chez le nouveau-né, *Obstétrique.* 8: 518-525.

Maffucci, Angelo & Luigi Sirleo. 1895. Osservazioni ed esperimenti intorno ad un blastomicete patogeno con inclusione dello stesso nelle cellule dei tessuti patologici, *Policlinico Sez. Chirurg.* 2: 138-144.

—. 1895. Nuovo contributo alla patologia di un blastomicete, *Policlinico Sez. Chirurg.* 2: 245-254.

—. 1895. Beobachtungen und Versuche über einen pathogenen Blastomyceten bei Einschluss desselben in die Zellen der pathologischen Gewebe, *Centralbl. Allg. Path. Path. Anat.* 6: 305-313.

—. 1895. Neue Beitrag zur Pathologie eines Blastomyceten, *Centralbl. Allg. Path. Path. Anat.* 6: 438-448.

—. 1896. Weitere experimentelle Untersuchungen über einen pathogenen Blastomyceten, *Centralbl. Allg. Path. Path. Anat.* 7: 977-985.

—. 1898. Über die Blastomyceten als Infektionserreger bei bösartigen Tumoren, *Zeitschr. Hyg.* 27: 1-30.

*Magalhães, Octavio de. 1914. Mycose pulmonar. Oidium pulmoneum (n. sp.), *Brasil Med.* 28: 313.

—. 1916. Mycose pulmonar produiza pelo Oidium brasiliense, *Brasil Med.* 30: 25-28.

—. 1918. Ensaios de mycologia I, *Brasil Med.* 32: 185, 186.

—. 1918. Nova micose humana. Estudo sobre a morfolojia e biolojia do Oidium brasiliense n. sp. ajente etiologico de uma nova molestia de homen, *Mem. Inst. Oswaldo Cruz.* 10: 20-61, *Pls. 4-14.*

—. 1927. Contribuição para o conhecimento das lesões provocadas pelo Oidium brasiliense, *Brasil Med.* 41: 1341, 1342, *1 fig.* **Mem. Inst. Oswaldo Cruz.* 22: 27-37, *Pls. 6-33,* 1929.

—. 1932. A classificão do ''Oidium brasiliense'' Neogeotrichum pulmoneum n.g. (O. Magalhães 1914) emend. O. Magalhães 1931, *Mem. Inst. Oswaldo Cruz.* 26: 151-167, *Pls. 36-40.*

*Magalhães, Pedro Severiano de. 1901. Um caso autochtone de piedra, *Rev. Med. São Paulo.* :143.

*—. 1906. Um novo caso autochtone de piedra, *Rev. Med. São Paulo* :105.

Maggiora, A. & G. Gradenigo. 1890. Bakteriologische Beobachtungen über den Inhalt der Eustachischen Trompete bei chronischen katarrhalischen Mittelohrenentzündung, *Centralbl. Bakt.* 8: 582-589.

Magrou, J. 1916. Sur un cas de blastomycose pulmonaire, *Montpellier Méd.* 39: 278-282, *2 figs.*

Maillard, Edgar R. 1931. Electrodesiccation of tonsils harboring Monilia Krusei Castellani and nonvirulent diphtheria bacilli, *New York State Med. Jour.* 31: 895.

Malassez, L. 1874. Note sur le champignon du pityriasis simple, *École Prat. Hautes Études, Lab. d'Histol. Coll. France Trav.* 1: 170-183, *Pl. 9.*

—. 1874. Note sur le champignon de la pelade, *Arch. Physiol. Norm. Path.* II, 1: 203-212, *Pl. 11* [6].

—. 1874. Note sur le champignon du pityriasis simple, *Arch. Physiol. Norm. Path.* II, 1: 451-464, *Pl. 20.*

Mallardo, Cesare Amatucci. 1929. Observations on Cryptococcus Castellanii Re and Cryptococcus graciloides Castellani, *Jour. Trop. Med. Hyg.* 32: 145-147, *3 figs.*

Maner, G. D. & R. W. Hammack. 1930. Systemic blastomycosis, *Calif. West. Med.* 32: 87-90, *2 figs.*

Maneval, W. E. 1924. A method of securing spores of yeasts, *Bot. Gaz.* 78: 122, 123.

—. 1929. Some staining methods for bacteria and yeasts, *Stain Techn.* 4: 21-25.

Manson-Bahr, P. 1932. Trichosporon Beigeli parasitic on human hair from Nigeria, *Trans. R. Soc. Trop. Med. Hyg.* 26: 9.

Marantonio, Roberto. 1893. Contributo alla biologia del fungo del mughetto, *Ann. Ist. Ig. Roma.* 3: 199-223.

Marcone, Giuseppe. 1895. La saccaromicosi degli equini (farcino d'Africa, linfangite epizootica, farcino criptococchico ecc.), *Atti Ist. Incorrag. Napoli.* 8: 6:1-19, *1 pl.*

Marengo, G. 1926. Su di una paronichia dovuta ad una nuova specie di Monilia: la Monilia onychophila Pollacci e Nannizzi, *Arch. di Biol.* 3: 4:25-36, *2 figs.*

—. 1926. Su alcuni casi di dermite interdigitale delle mani di natura criptococcica, *Arch. Ital. Derm. Sifilogr. Ven.* 1: 464-477, *2 figs.*

Maresch, Rudolf. 1907. Zur Kenntnis der Soormykose des Magens, *Zeitschr. Heilk.* 28^{2}: 145-153, *Pl. 13.*

Marett, P. J. 1932. Bronchomoniliasis. *Brit. Med. Jour.* 1: 1190.

—. 1933. A note on Monilia infection of the respiratory tract, *Brit. Med. Jour.* 1: 917.

Margarinos Torres, C. B. & A. E. de Arêa Leão. 1924. Leishmaniose e blastomycose (Observação das duas molestias), *Sciencia Med.* 2: 256-259, *1 fig.*

Markees, Christian. 1901. Ueber den Soorpilz. Beitrag zur Pathogenese und zur Kenntnis der Kugelzellbildung des Pilzes. *Diss. Univ. Basel,* 44 pp., *2 pls.*

Marotta, Radegondo G. 1926. Bronchiti e broncoalveoliti da Oidium albicans, *Folia Méd.* 12: 713-717.

Marowsky, Louis. 1868. Zur Lehre von dem Wesen des Hautpigmentes bei der Broncekrankheiten, Bronzed skin, Morb. Addisonii, *Deutsch. Arch. Klin. Med.* 4: 465-475, *2 figs.*

Martinotti, L. 1925. Rara osservazione di emisporosi, *Giorn. Ital. Derm. Sifilol.* 66: 389-392, *1 pl.*

Martins, César. 1928. Zymonema pulmonalis membranogenes isolé d'un crachat de pneumopathie grave et mortelle, *C. R. Soc. Biol.* 98: 1162-1164.

Marzinowski, E. J. & S. L. Bogrow. 1907. Die Blastomyceten und ihre Beziehung zu Hautkrankheiten, *Arch. Derm. Syphilis* 86: 214-237, *Pls. 7, 8.*

Maschkilleisson, L. N. 1926. Zur Frage der Gilchristschen Hautblastomykose, *Derm. Woch.* 83: 1236-1243, 1271-1282.

Massee, Joseph C. & J. Stewart Rooney. 1930. Meningitis due to Torula histolytica. Report of a case, *Jour. Am. Med. Ass.* 94: 1650-1653.

Matakieff, Elie. 1899. Le pityriasis versicolor et son parasite, *Thèse Fac. Méd. Univ. Nancy* 51: 1-75, *1 pl.*

Matzenauer, Rudolf. 1901. Zur Bakteriologie der Pityriasis versicolor, *Arch. Derm. Syphilis* 56: 163-168, *Pls. 9, 10.*

Mautner, Hans. 1914. Eine bisher nicht beobachtete Moniliaart bei chronischer Bronchitis, *Wien. Med. Woch.* 64: col. 1065-1067.

—. 1914. Parendomyces pulmonalis Plaut, eine bisher nicht beschriebene Moniliaart, *Centralbl. Bakt.* I, 74: 207, 208.

Mazza, Salvador & Benito Palamedi. 1932. Caso mortal de blastomicosis cutáneo mucosa, *Reunión Soc. Argentina Patol. Reg. del Norte, Tucumán* 7: 424-467, *1 pl., 50 figs.*

Mazza, Salvador & Carlos S. Poma. 1932. Un nuevo caso de moniliasis vaginal, *Reunión Soc. Argentina Patol. Reg. del Norte, Tucumán* 7: 468-471.

Mazza, Salvador & Fortunato Canevari. 1930. Ulceras blastomicosicas de la lengua, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 226-230, *4 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

Mazza, Salvador & Flavio Niño. 1928. Notas sobre blastomicosis de las vías respiratorias, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* [4]: 545-558, *Fig. 15.*

Mazza, Salvador, Flavio Niño & Antonio Egües. 1929. Perionyxis blastomicética por Monilia (n. sp.), *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 284-288, *1 pl., 3 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

Mazza, Salvador, Flavio Niño & Raul Nicolini. 1930. Blastomicosis de la mucosa labiogeniana, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 231-239, *10 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

Mazza, Salvador, Falvio Niño, Hector Quintana & Vicente Bernasconi. 1931. Blastomicosis grave generalizada por Monilia n. sp., *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 180-214, *38 figs.* [*6ta Reunión Soc. Argent. Patol. Reg. del Norte, Salta,* 1930.]

Mazza, Salvador, L. Stabile de Nucci & E. J. Canal Feijóo. 1930. Blastomicosis cutanea de forma lenta por criptococo (n. sp.), *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 293-308, *21 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

Mazza, Salvador & Silvio Parodi. 1927. Micosis laríngea con parásitos análogos a los megasporídeos de Posadas, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 3: 909-914, *5 figs.* [*3ra Reunión Soc. Argent. Patol. Reg. del Norte, Tucumán,* 1927.]

—. 1928. Una micosis chaqueña de la laringe causada por un nuevo tipo de hongo, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* [4]: 539-544.

*—. 1929. Micosis chaqueña producida por el Pseudococcidioides Mazzai (DaFonseca 1928), *Prensa Méd. Argentina* 16: 268-272, *4 figs.*

Mazza, Salvador & Miguel de los Ríos. 1931. Sobre un caso de moniliasis vaginal, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 215-225, *13 figs.* [*6ta Reunión Soc. Argent. Patol. Reg. del Norte, Salta,* 1930.]

Mégnin, P. 1895. Affection ulcéro-végétante infectieuse (pappilome infectieux) des lèvres des agneaux, *C. R. Soc. Biol.* **47**: 644-646, *1 fig.*

Meirowsky, E. 1911. Über das Wesen der Unnaschen Flaschenbazillen und über den feineren Bau einiger Hautpilze, *Arch. Derm. Syphilis* **108**: 129-140, *Pl. 10.*

Mello, Froilano de. See Froilano de Mello, Indalencio.

Mellon, Ralph R. 1925. Observations on an ascospore stage for the parasites of blastomycosis hominis, *Proc. Soc. Exp. Biol. Med.* **22**: 69.

—. 1926. Studies in microbic heredity. VI. The infective and taxonomic significance of a newly described ascospore stage for the fungi of blastomycosis, *Jour. Bact.* **11**: 229-252, *Pls. 1-4.* VII. Observations on the genetic origin of the several types of fungi found in lesions of blastomycosis hominis, *Jour. Bact.* **11**: 419-431, *5 figs.*

Mendelson, Ralph W. 1921. An exceptional tropical ulceration, *Jour. Trop. Med. Hyg.* **24**: 316, *2 figs.*

Mendola, & Agosta. 1927. Lesioni sperimentali articolari da Monilia tropicalis Castellani, *Riforma Med.* **43**: 1150.

Merke, F. 1924. Über die Bedeutung des Soorpilzes für das chronische Magengeschwür, *Beitr. Klin. Chirurg.* **130**: 549-566, *Pls. 11-13.*

Mibelli, A. 1930. A proposito di epidermomicosi acromizzanti (epidermomicosi da Hemispora stellata), *Giorn. Ital. Derm. Sifilol.* **71**: 1005-1009.

Michel, Carl. 1917. A study of toxins and the serological reactions in sprue, *Am. Jour. Med. Sci.* **154**: 177-181.

Michelson, I. D. 1928. Blastomycosis. Pathological and bacteriological studies, *Jour. Am. Med. Ass.* **91**: 1871-1876, *6 figs.*

Michelson, I. D. & Anna Dean Dulaney. 1931. Experimental blastomycosis, *Southern Med. Jour.* **24**: 1034-1041.

Miègeville. 1924. Note clinique sur la blastomycose oculaire de l'âne, *Bull. Soc. Path. Exot.* **17**: 543-545.

Miescher. 1921. Oidium als Erreger einer pustulösen Dermatitis, *Schweiz. Med. Woch.* **2**: 139.

Milochevitch, S. 1929. Das Wachstum und die Wachstumsformen des Soorpilzes auf verschiedenen Nährböden besonders auf solchen die mit Extrakten aus Körperorgane hergestellt wurden, *Centralbl. Bakt.* I, **114**: 174-185.

Minchin, E. A. & H. B. Famtham. 1905. Rhinosporidium Kinealyi n. g., n. sp., a new Sporozoan from the mucous membrane of the septum nasi of man, *Quart. Jour. Micr. Sci.* **49**: 521-532, *Pls. 30, 31.*

Mitchell, James Herbert. 1922. Erosio interdigitalis blastomycetica, *Arch. Derm. Syphilol.* **6**: 674-679, *5 figs.*

—. 1929. Amycotic dermatoses simulating ringworm and erosio interdigitalis blastomycetica, *Arch. Derm. Syphilol.* **19**: 659-670, *12 figs.*

Moinson, Louis. 1922. Les moniliases, *Jour. Méd. Paris.* **41**: 688-690.

Molènes, P. de & J. Costilhes. 1891. Pityriasis versicoloré. Pathogénie, traitement, *Arch. Gén. Méd.* VII, **28**: 385-406.

Monbreun, W. A. de. 1934. The cultivation and cultural characteristics of Darling's histoplasma capsulatum, *Am. Jour. Trop. Med.* **14**: 93-125, illus.

*Monnier. 1897. Considérations sur les mycoses cérébrales et plus particulièrement sur la généralisation du muguet, *Gaz. Méd. Nantes.*

Montel, R. A. & R. Pons. 1926. Dermatite blastomycosique chéloïdienne, *Bull. Soc. Path. Exot.* **19**: 876-880, *2 figs.*

Montenegro, João. 1927. Acerca da inoculabilidade da blastomycose no Brasil, *Brasil Med.* **41**: 808-812.

Montgomery, Douglass W. 1900. A disease caused by a fungus; the protozoic dermatitis of Rixford & Gilchrist, *Brit. Jour. Derm. Syphilis* **12**: 343-350, *2 pls.*

Montgomery, Douglass W., Hal Ryfkogel & Howard Morrow. 1903. Dermatitis coccidioides, *Jour. Cut. Gen.-Urin. Dis.* **21**: 5-10, *1 pl.*

Montgomery, Frank Hugh. 1902. A preliminary report of two cases of cutaneous blastomycosis (blastomycetic dermatitis of Gilchrist), *Jour. Cut. Gen.-Urin. Dis.* 20: 195-203, *1 fig.*

Montgomery, Frank Hugh & O. S. Ormsby. 1908. Systemic blastomycosis: its etiological, pathological and clinical features as established by a critical survey and summary of twenty-two cases (eight of them unpublished); the relation of blastomycosis to coccidioidal granuloma, *Internat. Derm. Congr.* (New York) 6: 1:365-409, *Pls. 18-20.* [Reprinted with slightly variant title, *Arch. Int. Med.* 2: 1-41, *17 figs.*, 1908.]

Montgomery, Frank Hugh & Howard Taylor Ricketts. 1901. Three cases of blastomycetic infection of the skin, one case limited to a tumor of the lower lip, *Jour. Cut. Gen.-Urin. Dis.* 19: 26-43.

Montgomery, Frank Hugh & Walker. 1901. Further report of a previously recorded case of blastomycosis. Systemic infection with Blastomyces; death; autopsy, *Amer. Derm. Ass.* 21: 102-111, *2 figs.*

Montpellier, J. & A. Catanei. 1926. Langue pileuse et sableuse avec Monilia, *Ann. Derm. Syphiligr.* VI, 7: 78-87.

—. 1926. Présence du même Monilia chez deux malades porteurs de lésions différentes de la cavité buccale, *C. R. Soc. Biol.* 95: 568, 569.

Moore, Morris. 1932. Coccidioidal granuloma: a classification of the causative agent, Coccidioides immitis, *Ann. Missouri Bot. Gard.* 19: 397-428, *Pl. 25.*

—. 1933. Blastomycosis: Report of a case with a study of an etiologic factor and a classification of the organism, *Ann. Missouri Bot. Gard.* 20: 49-118, *Pls. 6, 7.*

—. 1933. A study of Endomyces capsulatus Rewbridge, Dodge and Ayers: a causative agent of fatal cerebrospinal meningitis, *Ann. Missouri Bot. Gard.* 20: 471-568, *Pls. 16-23.*

—. 1934. Posadasia pyriformis and P. capsulata, two causative organisms of Darling's histoplasmosis in the United States, *Ann. Missouri Bot. Gard.* 21: 347, 348.

—. 1934. A new Geotrichum from a bronchial and pulmonary infection Geotrichum versiforme, n. sp. *Ann. Missouri Bot. Gard.* 21: 349-366, *Pls. 15, 16.*

—. 1935. Cytology of Geotrichum versiforme Moore, 1934. *Ann. Missouri Bot. Gard.* 22: 307-316, *Pls. 7, 8.*

—. 1935. A morphological and physiological study of two species of Posadasia: P. capsulata (Darling) Moore and P. pyriformis, *Ann. Missouri Bot. Gard.* 22: 335-360, *Pls. 11-14.*

—. 1935. An ear infection caused by a new Hemispora: H. coremiformis n. sp., *Ann. Missouri Bot. Gard.* 22: 317-334, *Pls. 9, 10.*

[Moore, Morris], Cyril M. MacBryde & Ewell Thompson. 1933. Meningitis and dermatitis caused by a new variety of blastomycete (endomycete), *Arch. Derm. Syphilol.* 27: 49-69, *4 figs.*

Moppert, Gustav G. & J. Kagan. 1922. Recherches sur la présence de muguet (Oidium) dans la liquide gastrique d'individus normaux et d'individus atteints d'ulcère et de cancér de l'estomac, *Rev. Méd. Suisse Romande* 42: 505-509.

*Morowka. 1917. Der Pseudorotz (Lymphangitis epizootica). *Zeitsch. Veterinärkunde,* 453.

Morris, Malcolm. 1879. The Pathological Society . . . March 18. [Piedra], *Med. Times Gaz.* 1: 409.

Morris, Myrl. 1924. Coccidioides of the central nervous system, *California West. Med.* 22: 483-485.

Morris, Robert T. 1913. A case of systemic blastomycosis, *Jour. Am. Med. Ass.* 61: 2043, 2044.

Moses, Arthur. 1916. Blastomycose, *Brasil Med.* 30: 235, 236.

Moses, Arthur & Gaspar Vianna. 1913. Sobre nova micose humana, causada por cogumelo ainda não descrite Proteomyces infestans, *Mem. Inst. Oswaldo Cruz* 5: 192-210, *Pls. 14-18, 2 figs.*

Moss de Almeida, Henrique. 1916. Um foco epidemico de Piedra, *Brasil Med.* 30: 360.

Motta, Roberto. 1926. Nuova specie di Cryptococcus isolata dalla gola (Cryptococcus uvae Pollacci & Nannizzi), *Atti R. Accad. Fisiocrit. Siena* IX, 17: 633-637, *4 figs.*

—. 1926. Considerazioni su due casi di micosi delle fauxi, *Atti R. Accad. Fisiocrit. Siena* IX, 17: 639-654, *1 fig.*

*Mouchet, R. & R. van Nitsen. 1921. Sur une dermatite verruqueuse des noirs de la Rhodésie du Nord-Est, *Ann. Soc. Belge Méd. Trop.* 1: 235-239.

Mouradian. 1922. Chancre mycosique simulante le chancre syphilitique, *Ann. Mal. Vénér.* 17: 899, 900.

*Mrongovius, V. J. & M. S. Bashkevitch. 1930. Sur un cas de blastomycose d'une durée de 17 ans guéri par le levure de bière, *Russki Vestnik Dermatologii.* 8: 804-817.

Müller-Aspergren, U. 1921. Uréthrite et cystite à Saccharomyces avec ''pneumaturie,'' *Acta Dermato-Ven.* 2: 126.

Muende, I. 1931. Observations on Monilia, *Brit. Jour. Derm. Syphilis* 43: 3-19.

Muijs, D. 1916. Epidermomycosis inguinalis veroorzaakt door de Endomyces albicans, *Nederl. Tijdschr. Geneesk.* 60: 2150-2156, *2 figs.*

—. 1918. Endomyces albicans als Ursache einer Epidermomycosis inguinalis, *Derm. Woch.* 66: 65-71.

*Muniz, G. & P. Valladares. 1908. Piedra na Bahia, *Rev. Med. São Paulo.*

*Myahara, A. 1924. Sarcomycosis caused by Sarcomycetes Inokii Ota, *Jap. Jour. Derm. Urol.* 24:

Myers, Harold B. & Clinton H Thienes. 1925. The fungicidal activities of certain volatile oils of stereoptens, their comparative toxicity on a pathogenic yeast-like organism: report of clinical utilization in related infections, *Jour. Am. Med. Ass.* 84: 1985, 1986.

Nakamura, Toshiro. 1931. Über einen neuen für die Studie von Hefen bequemen Nahrboden, *Jap. Jour. Derm. Urol.* 31: 1574-1577 [165].

Nannizzi, Arturo. 1929. Note micologiche VI. Monilia cornealis, *Atti R. Accad. Fisiocrit. Siena* X, 4: 92-94.

Nasso, I. 1926. Un caso di broncomoniliasi [in una bambina], *La Pediatria* 34: 37-42.

Nègre, L. & A. Boquet. 1915-17. Sur la culture du parasite de la lymphangite épizootique, *Bull. Soc. Path. Exot.* 8: 49-52, 1915; 10: 274-276, 1917.

—. 1918. Culture en série et évolution chez le cheval du parasite de la lymphangite épizootique, *Ann. Inst. Pasteur* 32: 215-241, *3 figs.*

Nègre, L., A. Boquet & G. Roig. 1918. Mycothérapie de la lymphangite épizootique, *Bull. Soc. Path. Exot.* 11: 609-616.

Nègre, L. & J. Bridré. 1911. Un cas de lymphangite épizootique chez l'homme. Traitement et guérison par le 606, *Bull. Soc. Path. Exot.* 4: 384-386.

*Negroni, Pablo. 19??. [Los hongos parásitos del hombre], *El día médico* 2: 897-899; 3: 93-95, 125-127, 269-272, 337-340, 434, 435, 555-564.

—. 1929. Sur une nouvelle espèce de Saccharomyces, S. annulatus n. sp., *Ann. Parasitol. Hum. Comp.* 7: 303-308.

—. 1930. Cryptococcus sp. aislados de epidermomicosis, *Rev. Soc. Argentina Biol.* 6: 648-652.

—. 1931. Cryptococcus sp. isolés de certaines épidermomycoses, *C. R. Soc. Biol.* 106: 389, 390.

—. 1931. Statistique de 157 cas de mycose étudiés à Buenos Aires, *C. R. Soc. Biol.* 108: 137, 138.

—. 1931. Estudio micologico sobre cincuenta casos de micosis, Tesis, *Revista Univ. Buenos Aires* II, 29: 237-398, *78 figs.* [IV. VIII. 3.]

—. 1931. Sobre el intertrigo blastomicética,* *Rev. Soc. Argentina Biol.* 7: 320-322. [Sur l'intertrigo blastomycétique, *C. R. Soc. Biol.* 108: 374-376.]

—. 1933. La déviation du complément dans les affections cutanéomuqueuses à Monilia, *C. R. Soc. Biol.* 113: 476-478.

—. 1933. Valeur comparative des réactions biologiques dans les moniliases cutanées et muqueuses, *C. R. Soc. Biol.* 116: 709-711.

—. 1934. Étude analytique de l'antigène Monilia albicans, *C. R. Soc. Biol.* 115: 342-344.

Nesczadimenko, M. P. 1899. Zur Pathogenese der Blastomyceten, *Centralbl. Bakt.* 25: 55-58.

Neuber, Eduard. 1925. Beiträge zur Pathogenese und Therapie der Gilchrist'schen Blastomykose, *Arch. Derm. Syphilis* 149: 182-195, *6 figs.*

Neumayer, Johann. 1891. Untersuchungen über die Wirkungen verschiedener Hefearten, welche bei der Bereitung weingeistiger Getränke vorkommen, auf den tierischen und menschlichen Organismus, *Arch. Hyg.* 12: 1-60.

New, Gordon B. 1928. Blastomycosis of the larynx, *Ann. Otol.* 37: 240-250, *7 figs.*

Newham, H. B., R. M. Morris & P. H. Manson-Bahr. 1926. A study of sprue and Addisonian anaemia, *Lancet* 2: 269-274.

Niño, Flavio L. 1930. Ensayos de immunización anticriptocóccica en los animales de laboratorio, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 156-171, *13 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

—. 1930. Ulceración blastomicética cutáneomucosa del labio inferior (Consideraciones acerca de su diagnóstico etiólogico), *Bol. Cín. Quirúrg. Univ. Buenos Aires* 5: 213-225, *9 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

—. 1930. Onixis y perionyxis de origen blastomicósico (Estudio clínico y micológico), *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 270-281, *9 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

—. 1931. Blastomicosis humana generalizada por Criptococo (n. sp.), *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 117-167, *Pls. 5-7, 60 figs.* [*6ta Reunión Soc. Argent. Patol. Reg. del Norte, Salta,* 1930.]

*—. 1933. Glositis blastomicetica, *Prensa Méd. Argent.* 20: 361-371, *20 figs.*

Niño, Flavio L. & Antonio Egües. 1932. Una nueva observación de onixis y perionixis de origen blastomicético, *Reunión Soc. Argent. Patol. Reg. del Norte, Tucumán* 7: 285-295, *2 pls., 2 figs.*

Niño, Flavio L. & Braulio Perez. 1932. Blastomicosis de la mucosa gingivo-geniana, *Reunión Soc. Argent. Patol. Reg. del Norte, Tucumán* 7: 413-423, *2 pls., 10 figs.*

Niño, Flavio L. & Julián Fernández. 1930. Nueva observación de perionixis per Monilia periunguealis, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 282, 283.

Niño, Flavio, L., Julián Fernández & Miguel Palant. 1931. Nuevas observaciones de onixis y perionixis de origen blastomicósico, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 35-99, *82 figs.* [*6ta Reunión Soc. Argent. Patol. Reg. del Norte, Salta,* 1930.]

Niño, Flavio L. & Alfio Puglisi. 1927. Moniliasis bucal. Su estudio clínico y micológico, *Semana Méd.* 34: 222-229, *9 figs.*

Noc, F. & Jouenne. 1922. Les mycétomes à grains noirs du Sénégal, *Ann. Inst. Pasteur* 36: 365-385.

Nogami, T. 1931. Über Kulturversuche von Mikroorganismen im trachomatösen Gewebe, *Klin. Monatsbl. Augenheilk.* 86: 313-316.

Noisette, George. 1898. Recherches sur le champignon du muguet, *Thèse Méd. Paris* 340: 139 pp.

Nolen, W. 1918. Indische spruw en pernicieuse anaemie, *Nederl. Tijdschr. Geneesk.* 62: 2:1515-1526.

Noronha, A. J. 1933. A preliminary note on the prevalence of rhinosporidiosis among sandworkers in Poona with a brief description of some histological features of the rhinosporidial polypus, *Jour. Trop. Med. Hyg.* 36: 115-120, *13 figs.*

—. 1933. Further observations on Rhinosporidiosis, *Jour. Trop. Med. Hyg.* 36: 368-370, *8 figs.*

Norris, J. C. 1931. A yeast pathogenic for man and animals (Saccharomycete pleomorphus virulens), *Southern Med. Jour.* 24: 482-489, *16 figs.*

Nye, Robert N., Leon G. Zerfas & M. Agnes Cornwell. 1928. The presence and importance of yeast-like fungi in the gastro-intestinal tract in pernicious anemia, in other diseases and in normal individuals, *Amer. Jour. Med. Sci.* 175: 153-174.

Ochi, S. 1931. Über eine Art von Mikroorganismen im trachomatösen Gewebe, *Klin. Monatsbl. Augenheilk.* 86: 309-313.

Odland, Henry & Rachel E. Hoffstadt. 1929. Eruption of the genitalia due to fungus (Monilia Pinoyi Castellani), *Arch. Derm. Syphilol.* 20: 335-338, *3 figs.*

*Oehl. 1929. Lymphangitis epizootica beim Schwein. Ein Beitrag Zur Kasuistik, *Deutsch. Tierarztl. Woch.* 37: 39, 40.

Okabe, Yozaburo. 1924. Studien über den Soorpilz. I. Bakteriologische Eigenschaften und systematische Stellung des Soorpilzes, *Centralbl. Bakt.* I, 111: 181-187, *Pl. 1.* II. Ueber die Pathogenese der Soorkrankheit, *Ibid.* I, 111: 187-194, *Pls. 2-4.*

Oliver, H. Gordon. 1932. Bronchomoniliasis in Jersey, *Brit. Med. Jour.* 1: 863.

Oliver, Wade W. 1920. Cultural studies on a case of sprue, *Jour. Amer. Med. Ass.* 74: 27, 28.

Ophüls, W. 1905. Further observations on a pathogenic mould formerly described as a protozoan. (Coccidioides immitis, Coccidioides pyogenes), *Jour. Exp. Med.* 6: 443-485, *Pls. 34-38.*

—. 1905. Coccidioidal granuloma, *Jour. Amer. Med. Ass.* 45: 1291-1296, *16 figs.*

Ophüls, W. & Herbert C. Moffitt. 1900. A new pathogenic mould (formerly described as a protozoan Coccidioides immitis pyogenes) preliminary report, *Philadelphia Med. Jour.* 5: 1471, 1472.

Oppenheim, Moriz. 1908. Die Hautblastomykose (dermatitis blastomycetica), *Internat. Derm. Cong.* 6: 346-364.

—. 1933. Zur Aetiologie der Schwarzen Haarzunge (lingua pilosa nigra), *Wiener Klin. Woch.* 46: 719-722.

Ormsby, Oliver S. & H. M. Miller. 1903. Report of a case of systemic blastomycosis with multiple cutaneous and subcutaneous lesions, *Jour. Cut. Dis.* 21: 121-136, *Pls. 14-17.*

*Osorio. 1876. *Revista Méd.*

Ostrovsky, Emmanuel. 1896. Recherches expérimentales sur l'infection générale produite par le champignon du muguet, *Thèse de Paris,* 93 pp.

Ota, Masao. 1917. Über Blastomycosis cutis, *Festschrift gewidmet Keizo Dohi* 335-350, *Pls. 32, 33.* [*Ergänzungsband zur Jap. Zeitschr. Derm. Urol.*]

—. 1923. Cinq levures du genre Debaryomyces considérées comme pathogènes, *Ann. Parasitol. Hum. Comp.* 1: 124-136.

—. 1924. Beiträge zur Morphologie, Biologie und Systematik der pathogenen asporogenen Sprosspilze, *Derm. Woch.* 78: 216-237, 260-265.

—. 1924. Über vier neue pathogenen Hefearten von der Gattung Debaryomyzes (Klöcker), *Derm. Woch.* 78: 284-289, 312-316.

—. 1924. Essai de classification des blastomycètes pathogènes, *Ann. Parasitol. Hum. Comp.* 2: 34-61.

—. 1925. Le Cryptococcus farciminosus Rivolta doit prendre place parmi les dermatophytes du genre Grubyella, *Ann. Parasitol. Hum. Comp.* 3: 71-78.

—. 1925. Remarques complémentaires sur la levure pathogène de Favre (Myceloblastanon Favrei n. sp.), *Ann. Parasitol. Hum. Comp.* 3: 181-184, *1 fig.*

—. 1926. Sur quelques champignons pathogènes du type Trichosporum Beigeli Vuillemin, *Ann. Parasitol. Hum. Comp.* 4: 1-13, *3 figs.*

Ota, Masao & R. Masuda. 1930. Ein Fall von akuter Zystitis verursacht durch eine pathogene Hefe, *Derm. Woch.* 91: 1521-1527.

Ota, Masao & Shûji Kawatsure. 1933. Zur Aetiologie der echten und falschen Blastomykosen, besonders der Gilchristschen Krankheit, *Arch. Derm. Syphilis* 169: 149-172, *11 figs.*

Ota, Masao & Ping Ting Huang. 1933. Sur les champignons du genre Pityrosporum Sabouraud, *Ann. Parasitol. Hum. Comp.* 11: 49-69, *2 figs.*

Otis, F. J. & Newton Evans. 1903. The morphology and biology of the parasite from a case of systemic blastomycosis, *Jour. Amer. Med. Ass.* 41: 1075-1082.

Oulmann, 1922. Blastomycosis, *Arch. Derm. Syphilol.* 6: 381.

Owens, John E., Daniel N. Eisendraht & C. F. W. Ready. 1899. Blastomycetic dermatitis (Pseudolupus vulgaris, saccharomycosis hominis or pseudoepithelioma with Blastomycetes), *Ann. Surg.* 30: 545-563, *9 figs.*

Pais, Luigi. 1921. Due casi di piedra nostras, *Riforma Med.* 37: 266, 267.

*Pamperin, 1921. Die Wirkung einiger Disinfektionsmittel auf die Kultur des Cryptococcus farciminosus. *Inaug. Diss.*

Panayotaton, Angelica. 1930. A case of Castellani's bronchomoniliasis with Monilia Alessandrina as the etiological agent, *Jour. Trop. Med. Hyg.* 33: 17, 18.

Paoli, Astolfo. 1913. Un caso di trichosporia, *Giorn. Ital. Mal. Ven. Pelle* 54: 566-572, *1 pl.*

Parise, Nicola. 1923. Contributo sulla moniliasi simulatrice di tuberculosi pulmonari, *Riforma Med.* 39: 241, 242.

Parmanand, M. J. 1922. Notes on a case of bronchomoniliasis, *Indian Med. Gaz.* 57: 418, 419, *1 pl.*

Parodi, Silvio E. 1927. Sobre un nuevo caso de Rhynosporidium. Ensayos de inoculación experimental, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 3: 331-335, *3 figs.* [*3ra Reunión Soc. Argent. Patol. Regional del Norte, Tucumán,* 1927.]

Parrot, J. 1869. Du muguet gastrique et de quelques autres localisations de ce parasite, *Arch. Phys. Norm. Path.* 2: 504-517, 579-599, *Pl. 14.*

—. 1870. Note sur un case de muguet du gros intestin, *Arch. Phys. Norm. Path.* 3: 621-625.

Pautrier, L. M. 1934. Blastomycose végétante de la face, *Bull. Soc. Franç. Derm. Syphiligr.* 41: 212-217.

Pawloff, P. A. 1908. Ein Fall von Blastomycosis der Haut, *Monatsh. Prakt. Derm.* 47: 543-552, *1 pl.*

Peckham, Jane F. 1925. Study of yeasts from human sources, *Jour. Inf. Dis.* 37: 53-61.

Péju, G. & Alexandre Guilliermond. 1922. Mycoses pharyngées. Une espèce mycosique nouvelle Debaryomyces Klöcker, *Rev. Méd. de l'Est. Nancy.* 50: 342-347.

Pelagatti, Mario. 1897. Blastomyceten und hyaline Degeneration, *Arch. Path. Anat. Phys.* [Virchow] 150: 247-259, *Pl. 5.*

Pellier. 1910. Sur une lymphodermite végétante à Saccharomyces (S. granulatus de Vuillemin et Legrain), *Ann. Derm. Syphiligr.* V, 1: 191-196.

—. 1912. Sur une nouvelle forme parasitaire des onychomycoses, *Ann. Derm. Syphiligr.* V, 3: 563-565, *2 figs.*

Pels, Isaac R., Irmgaard Dresel & Robert Salinger. 1926. An unusual eruption due to an organism of the Monilia group, *Arch. Derm. Syphilol.* 14: 280-293, *8 figs.*

Pena, Raul. 1931. Sur les champignons producteurs de la piedra au Brésil, *C. R. Soc. Biol.* 108: 1073-1075.

Peña Chavarría, Antonio. 1928. Algunas consideraciones clinicas sobre la blastomicosis de las mucosas nasobucco-faringeas, fundados en observaciones hechas en varios países de la América Latina, *Rev. Med. Latin-Amer.* 13: 1290-1302, *10 figs.*

Peña Chavarría, Antonio & Janet H. Clark. 1924. The reaction of pathogenic fungi to ultraviolet light and the rôle played by pigment in this reaction, *Am. Jour. Hyg.* 4: 639-649, *6 figs.*

Peña Chavarría, Antonio & Werner Rotter. 1933. Die Kolumbianische Piedra, *Arch. Schiffs-u. Tropenhyg.* 37: 73-87, *16 figs.*

*Peneido Monteiro, P. 1925. Sobre dois casos de otomycoses, *Tribuna Med. Rio de Janeiro* 31: 232-238.

Penna de Azevedo, A. 1932. Plaques conjonctives meningées dans le blastomycose par le Coccidioides immitis, *C. R. Soc. Biol.* 109: 125-128.

Pereira Filho. 1927. Macroglossia mycotica, *Jour. Trop. Med. Hyg.* 30: 8-10.

—. 1930. Culturas da piedra brasiliera. Piedraia Sarmentoi n. sp., *Rev. Med. Cirurg. Brasil.* 38: 49, 50, *Pls. 1-6* [English translation 51, 52].

—. 1930. Cultures de piedra brésilienne. Piedraia Sarmentoi n. sp., *C. R. Soc. Biol.* 104: 680-682.

Peruchena, José G. 1929. Sobre un caso de moniliasis pulmonar, *Semana Méd.* 36: 527-535, *10 figs.*

Peruchena, José G. & Eduardo A. Pedace. 1929. Moniliasis. Estudio histologico de las alteraciones celulares y de las lesiones observadas en los animales de experimentación, *Semana Méd.* 36: 1075-1085.

Peruzzi, Mario. 1927. Sulle cellule giganti intraepiteliali della blastomicosi brasiliana di Splendore, Ricerche istologiche, *Ann. Med. Nav. e Colon.* 33: 1: 3-13, *1 pl.*

Petersen, Walther & Alfred Exner. 1899. Über Hefepilze und Geschwülstbildung, *Beitr. Klin. Chirurg.* 25: 769, 780, *Pls. 8-10.*

Petges, G. 1921. L'eczéma mycosique, *Bull. Soc. Franç. Derm. Syph.* 28: 185-192.

—. 1922. Rapport sur les épidermomycoses, *Cong. Derm. Syphiligr. Langue Franç.* 1: 13-31 [summarized without bibliography, *Paris Méd.* 47: 256, 257, 1923].

—. 1923. L'eczéma et l'intertrigo mycosiques, épidermomycoses eczématoïdes et intertriginoïdes, *Paris Med.* 47: 249-251.

*Peyri, Antonio & M. Casanovas. 1932. Moniliosis bucal, *Ecos Españoles, Derm. Sifiligr.* 8: 325.

Phalen, J. M. & Henry J. Nichols. 1908. Blastomycosis of the skin in the Philippine Islands, *Philippine Jour. Sci.* B, 3: 395-403, *Pls. 1-4.*

Pick, L. 1920. Arterienarrosion durch Soorpilze mit tödlicher Blutung, ein Beitrag zur Kenntnis der Oidiomykosen, *Berlin. Klin. Woch.* 57: 2: 798-802, *3 figs.*

*Pierangeli, W. 1925. Di um caso d'uretrite da Oidium albicans, *Rinasc. Med.* 2: 139.

Pierini, L. E. 1931. Dos casos de acromia por pityriasis versicolor, *Rev. Argentina Dermatosifilog.* 14: 41-47.

Pierson, Philip H. 1917. Torula in man. Report of a case with necropsy findings, *Jour. Am. Med. Ass.* 69: 2179-2181.

Piettre, Maurice & Germano de Souza. 1922. Milieux acides pour l'isolement des champignons, *C. R. Soc. Biol.* 86: 336, 337.

—. 1922. Isolement des levures en milieux acides, *C. R. Soc. Biol.* 86: 338-340.

Pijper, Adrianus. 1916. A preliminary note on a case of thrush-like disease due to Monilia rugosa Castellani, 1910, *Jour. Trop. Med. Hyg.* 19: 249.

—. 1917. Some unusual infections. II. Moniliasis, *Med. Jour. S. Africa* 12: 129, 130.

—. 1917. A new thrush parasite, *Jour. Trop. Med. Hyg.* 20: 169, 170. [*Am. Med. Jour.* 69: 854, 1917.]

—. 1923. Bronchomoniliasis and Monilia-fungi in sputum, *Med. Jour. S. Africa* 19: 101-111, *5 figs.*

—. 1928. A new Hanseniospora, *K. Akad. Wetensch. Amsterdam. Proc.* 31: 989-992.

Pineau, Jean. 1898. Le muguet infectieux et plus particulièrement le muguet infectant ou généralisation du muguet chez l'homme, *Thèse, Paris* 244: 1-76.

Pirani, Armando. 1928. Su di un saccaromicete simulante il mughetto nei bambini, *Ann. Ig. Sperim.* 38: 643-647.

Plass, E. D., H. C. Hesseltine & I. H. Borts. 1931. Monilia vulvovaginitis, *Am. Jour. Obstet. Gynecol.* 21: 320-324.

Plaut, Hugo Carl. 1885. Beitrag zur systematischen Stellung des Soorpilzes in der Botanik. H. Voigt, Leipzig, 16 pp., *2 figs.*

—. 1887. Neuer Beitrag zur Systematik des Soorpilzes. H. Voigt, Leipzig, 32 pp., *1 pl.*

*—. 1913. Soor, *Spezielle Path. Therap. innerer Krank.* [F. Kraus & Th. Brugsch] 2: 2:390.

—. 1919. Mykosen, *Spezielle Path. Therap. innerer Krank.* [Kraus & Brugsch] 2: 567-651, *Pls. 14-21, Figs. 72-114.*

—. 1921. Beitrag zur kenntnis der Mikroorganismen der Kopfhaut, *Arch. Derm. Syphilis* 131: 378-383.

*Plevaka, E. A. Monilia kak vozbuditel' onychomycosis i paronychia, *Zhurnal Mikrobiol. Immunobiol.* 7: 230-232, *1 pl.*

Plimmer, H. G. 1899. Vorläufige Notiz über gewisse von Krebs isolierte Organismen und deren pathogene Wirkung in Tieren, *Centralbl. Bakt.* 25: 805-809.

—. 1899. The etiology and histology of cancer, *Practitioner* 62: 430-455, *3 pls.*

Pollacci, Gino & Arturo Nannizzi. 1927. Sui caratteri dei generi Monilia e Cryptococcus, *Atti R. Accad. Fisiocrit. Siena.* X, 2: 35-43, *3 figs.*

Popoff, Nicolas W., Francis Ford & W. Harold Cadmus. 1929. Mycotic vulvovaginitis, *Am. Jour. Obstet. Gyn.* 18: 315-320.

Porak. 1896. Observations d'une lésion parasitaire de la langue chez le nouveau-né, *Jour. Mal. Cut. Syph.* 8: 20-24, *1 fig.*

*Posadas, Alejandro. 1897. Über eine neue durch Protozoen verursachte und auf Thiere übertragbare Geschwülstbildung am Menschen. Infectiöse generalisierte Psorospermosis. Buenos Aires. [*Monatsh. Prakt. Derm.* 27: 593, 1898.]

*—. 1898. Ensayo sobre una nueva neoplasia del hombre, producida por un protozoario y transmisible a los animales. Comunicación a la Academía de Buenos Aires. Jacobo Peuser, Buenos Aires.

—. 1900. Psorospermiose infectante généralisée, *Rev. Chirurg.* 21: 277-282, *7 figs.*

Potron, Maurice. 1903. A propos de blastomycètes dans les tissus. Recherches morphologique application des caractères de la membrane à la diagnose des blastomycètes dans les tissus, *Thèse de Nancy,* 227 pp.

—. 1911. Un cas d'adénite par l'Endomyces albicans, *Rev. Méd. de l'Est.* 43: 234, 235.

—. 1913. Infection pleuro-pulmonaire à Saccharomyces (Species?), *Rev. Méd. de l'Est.* 45: 636-638, *2 figs.*

—. 1913. Présence d'une levure au cours d'une infection pleuro-pulmonaire grave. Étude du Saccharomyces Etiennei (nova spec.), *Rev. Méd. de l'Est.* 45: 814-826, 841-855, *3 figs.*

Potron, Maurice & G. Noisette. 1911. Un cas de mycose, *Rev. Méd. de l'Est.* 43: 132-139, 161-171.

Procházka, K. 1925. Die Pathogenese der Blastomykosen, *Arch. Derm. Syphilis* 149: 511-518.

—. 1928. Pemphigus blastomyceticus, *Derm. Woch.* 87: 1759-1765.

Proescher, F. & A. P. Krueger. 1926. Report of a case of coccidioidal granuloma with autopsy findings, *Jour. Lab. Clin. Med.* 12: 57-70, *8 figs.*

*Proks, J. 1922. Oidium rubrum, *Lait.* 2: 716-719.

Pulford, D. Schuyler & E. Eric Larson. 1929. Coccidioidal granuloma report of a case treated by intravenous dye, colloidal lead and colloidal copper with autopsy observations, *Jour. Am. Med. Ass.* 93: 1049-1056, *13 figs.*

Queyrat, Louis. 1921. Mycose gingivale, *Bull. Soc. Franç. Derm. Syphiligr.* 28: 359-361.

Queyrat, Louis & Guy Laroche. 1909. Sur une mycose vaginale (Parendomyces albus). Étude microbiologique, expérimentale et thérapeutique, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 28: 111-136.

Quinquaud. 1868. Nouvelles recherches sur le muguet. Classification et conditions de développement du Syringospora Robinii (dit Oidium albicans), *Arch. Phys. Norm. Path.* 1: 290-305, *Pl. 8.*

Rabello, Eduardo. 1916. Caso de blastomycose, *Brasil Med.* 30: 205.

Rabinowitch, Lydia. 1896. Untersuchungen über pathogene Hefearten, *Zeitschr. Hyg.* 21: 11-24.

Rafin. 1910. Muguet du rein droit, *C. R. Ass. Franç. d'Urol.* 14: 455-462.

Raget, Martin. 1899. De l'entérite autoinfectieuse grippale à forme intermittente, *Cong. Méd. Montpellier* 1898-99, 133-136.

Raiford, Theodore S. 1932. Systemic blastomycosis with report of a case, *Bull. Johns Hopkins Hosp.* 51: 61-82, *10 figs.*

Rajat, Henri. 1906. Étude morphologique, cytologique et critique du champignon du muguet, *Thèse Fac. Méd. Lyon.* 9: 1-83.

Rajka, E. 1922. Soormykose der Haut, *Derm. Woch.* 74: 561-563.

Ramel, Edwin. 1925. Beitrag zur Kenntnis der Hautblastomykose mit besonderer Berücksichtigung der Allergieerscheinungen, *Arch. Derm. Syphilis* 148: 218-242.

Rand, Carl W. 1930. Coccidioidal granuloma: report of two cases simulating tumor of the spinal cord, *Arch. Neurol. and Psychiatr.* 23: 502-511, *5 figs.*

Rappaport, B. Z. & Bertha Kaplan. 1926. Generalized Torula mycosis, *Arch. Path. Lab. Med.* 1: 720-741, *11 figs.*

Raum, Johannes. 1891. Zur Morphologie und Biologie des Sprosspilze, *Zeitschr. Hyg.* 10: 1-50, *Pls. 1, 2.*

Ravaut, Paul & Longhin. 1931. Lésion première de l'intertrigo rétroauriculaire à levures. Eczéma second des bras et des jambes. Réactions biologiques, *Bull. Soc. Franç. Derm. Syphiligr.* 38: 177-181.

Ravaut, Paul & H. Rabeau. 1932. Les lévurides cutanées, *Presse Méd.* 39: 1925-1930, *8 figs.*

Ravogli, A. 1925. Blastomycosis, *Acta Dermato-venereol.* 6: 281-289, *Pls. 9-13.*

Re, Sergio. 1925. Observations on the cultural and biochemical characters of Monilia Castellanii (Cryptococcus Castelanii) and Monilia macroglossiae (Cryptococcus macroglossiae), *Jour. Trop. Med. Hyg.* 28: 317-319.

Rebaudi, U. 1925. Sulla dermatite blastomicetica di Gilchrist, *Arch. Ital. Derm. Sifilogr. Ven.* 1: 10-43.

Redaelli, Piero. 1923. Osservazioni istopatologiche e sperimentali sulla Moniliasi, *Lo Sperim.* 77: 397-422, *2 pls.*

—. 1924. Experimental moniliasis, *Jour. Trop. Med. Hyg.* 27: 211-213.

—. 1924. Contributo sperimentale allo studio della moniliase e della Lichtheimiasi, *Riforma Med.* 40: 665, 666.

*—. 1925. I miceti come associazione microbica nelle tuberculosi polmonare cavitaria. Osservazioni micopatologiche, istopatologiche e sperimentali. 99 pp., *9 pls.*, Pavia. [Atti Ist. Lombardo Sci. Lett.]

—. 1926. Osservazioni sulla deviazione del complemento nelle micosi sperimentale (Micosi da Candida Pinoyi Cast.), *Boll. Ist Sieroterap. Milanese.* 3: 157-162.

*—. 1927. Sul procedimento diagnostico per la determinazione specifica di fermenti e pseudofermenti asporigeni, *Boll. Soc. Med. Chir. Pavia* II, 41.

—. 1930. Notices sur la biologie du Coccidioides immitis et sur sa position systématique, *Bol. Sez. Ital. Soc. Internaz. Microbiol.* 2: 358-362.

—. 1931. Il problema delle Torulopsidaceae e dei loro rapporti con l'uomo e con la patologia umana studiato particolarmente in Italia. Blastomiceti e blastomicosi, *Riv. di Biol.* 13: 171-235.

Redaelli, Piero & Raffaele Ciferri. 1929. Studies on the Torulopsidaceae. Tentative regarding the diagnostic procedure for specific determination, *Centralbl. Bakt.* II, 78: 40-54.

—. 1934. Études sur le Coccidioides immitis Stiles. 2. Présence du granulome coccidioide en Europe, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 6: 255-257.

—. 1934. Gilchristia dermatitidis (Gilchr. et Stokes) Cif. et Red., the causative agent of the American Gilchrist disease (dermatitis verrucosa), *Jour. Trop. Med. Hyg.* 37: 280-282.

—. 1934. Études sur l'Histoplasma capsulatum Darling. 1. Réproduction expérimentale de l'histoplasmose, et définition de la maladie comme réticulo-histocytose parasitaire atteignant divers systèmes de l'organisme, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 6: 193-195.

—. 1934. Affinité entre les agents de l'histoplasmose humaine, du farcin equin et d'une mycose spontanée des murides, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 6: 376-379.

—. 1934. Studio comparativo di ventun ceppi di Sporendonema epizoum (Corda) Nobis (Hemispora stellata Vuillemin; Oospora d'Agatae Saccardo; ecc.), *Atti Ist. Bot. R. Univ. Pavia* IV, 5: 145-198, *5 figs.*

Redi, Rodolfo. 1930. Raro reperto urologico. Ife e conidiospore di un miceti (Monilia) in un bacinetto renale, *Atti R. Accad. Fisiocrit. Siena* X, 5: 43-46.

Reed, Albert C. & Harry A. Wyckoff. 1926. The common picture of sprue, pernicious anemia and combined degeneration, *Am. Jour. Trop. Med.* 6: 221-237.

Reess, Max. 1877. Über den Soorpilz, *Sitzungsber. Phys. Med. Soc. Erlangen.* 9: 190-195.

Reimann, Hobart A. & Timothy J. Kurotchkin. 1931. Attempts to produce bronchomoniliasis in monkeys, *Am. Jour. Trop. Med.* 11: 151-155.

Reiss, F. 1929. Caractères morphologiques de certaines espèces de Monilia, *Ann. Parasitol. Hum. Comp.* 7: 506-510 [tr. by M. Langeron].

—. 1931. Moniliasis cutis profunda, *China Med. Jour.* 45: 1037-1040, *2 pls.*

*Remak. 1845. Diagnostische und pathogenische Untersuchungen [see pp. 221-225].

Reschad-Bey. 1911. Eine Allgemeininfektion durch einen Soorpilz, *Med. Klin.* 7: 1734.

Rettger, Leo F. 1904. A contribution to the study of pathogenic yeasts, *Centralbl. Bakt.* I, 36: 519-527, *2 pls.*

Reubold. 1854. Beiträge zur Lehre vom Soor, *Arch. Path. Anat. Physiol.* [Virchow] 7: 76-114.

Rewbridge, Allan G., Carroll William Dodge & Theodore T. Ayres. 1929. A case of meningitis due to Endomyces capsulatus (new species), *Am. Jour. Path.* 5: 349-364, *Pls. 71-73.*

Ribbert, H. 1879. Abcess des Gehirns veranlasst durch Embolie des Oidiums albicans, *Berlin Klin. Woch.* 16: 617, 618.

Ribeyro, Ramón E. 1918. Sobre un caso de saccharomycosis labial, *An. Fac. Med. Univ. Lima,* 2: 122-127, *2 pls.* [Año 1, num. 5].

*—. 1920. *Laboratorio.* 3: 49.

Richter, W. 1928. Beiträge zur Hefepilzerkrankung, *Derm. Woch.* 87: 931-940, 978-990, 1231-1242.

Ricketts, H. T.: 1901. A new mould fungus as the cause of three cases of blastomycosis or oidiomycosis of the skin, *Jour. Boston Soc. Med. Sci.* 5: 453-459, *Pl. 37* [reprinted in his *Contributions to Med. Sci.* 11-17, *Pl. 1,* Chicago, 1911].

—. 1901. Oidiomycosis of the skin and its fungi, *Jour. Med. Res.* 6: 373-547, *Pls. 22-33* [reprinted in his *Contributions to Med. Sci.* 18-175, *Pls. 1-12,* Chicago, 1911].

Riehl Jr., Gustav. 1925. Durch pathogene sprosspilzenbedingte Granulome, *Arch. Derm. Syphilis* 148: 392-398.

Riesman, David & Florence E. Ahlfeldt. 1925. Coccidioidal granuloma, *Trans. Ass. Am. Physicians* 40: 300-307, *3 figs.*

—. 1927. Coccidioidal granuloma. I. Review of the clinical data with a report of a Pennsylvania case, *Jour. Med. Sci.* 174: 151-167.

Riley, F. B. & E. R. Le Count. 1914. A case of systemic blastomycosis, *Arch. Intern. Med.* 13: 614-616.

Risak, Erwin. 1925. Über eine seltene vermütlich durch einen Pilz hervorgerufene Granulationsgeschwülst des äusseren weiblichen Genitale, *Arch. Path. Anat. Phys.* [Virchow] 257: 744-750, *4 figs.*

Rischin, M. 1921. Ueber einen Fall von bisher noch nicht beschriebener Parendomyces-Erkrankung die unter dem Bilde der tiefen (Sycosis parasitaria) und oberflächlichen Trichophytie verlief, *Arch. Derm. Syphilis* 134: 232-242, *9 figs.*

*Rivolta, Sebastiano. 1873. Dei parassiti vegetali con introduzione allo studio delle malattie parassitarie e delle alterazioni dell'alimento degli animali domestici. Torino. 592 pp.

—. 1885. Sopra un nuovo fungo sarcomigeno nel cane, *Giorn. Anat. Fisiol. Patol. Animali* 17: 121-130, *Pl. 2.*

Rivolta, S. & I. Micellone. 1883. Del farcino cryptococcico, *Giorn. Anat. Fisiol. Patol. Animali* 15: 143-162.

Rixford, Emmet. 1894. A case of protozoic dermatitis, *Occidental Med. Times* 8: 704-707.

—. 1931. Early history of Coccidioidal granuloma in California, *California Dept. Public Health Special Bull.* 57: 5-8.

Rixford, Emmet & T. C. Gilchrist. 1896. Two cases of protozoan (coccidioidal) infection of the skin and other organs, *Johns Hopkins Hosp. Rept.* 1: 209-268, *Pls. 21-48.*

Rizzoli, Riccardo. 1931. Considerazioni su un caso di blastomicosi cutanea, *Arch. Ital. Derm. Sifilol. Venereol.* 7: 284-314, *9 figs.*

Robinson, Lewis Byrne & Mary Compton Moss. 1932. Superficial glossitis and perlèche due to Monilia albicans, their association with other forms of moniliasis, *Arch. Derm. Syphilol.* 25: 644-654, *5 figs.*

Rocha Lima, H. da. 1912. Histoplasmosis und epizootische Lymphangitis, *Arch. Schiffs- u. Tropenhyg. Beih.* 16: 1:79-85.

—. 1913. Beitrag zur Kenntnis der Blastomykosen-Lymphangitis epizootica und Histoplasmosis, *Centralbl. Bakt.* I, 67: 233-249, *1 pl.*

—. 1924. Ueber Blastomykose, venerisches Granulom und klimatische Bubonen, *Arch. Derm. Syphilis* 145: 312-317.

—. 1925. Histopathologie der exotischen Blastomykosen, *Zentralbl. Allg. Path.* 36: 231, 232.

Rockwood, Ethel M. & Arthur M. Greenwood. 1934. Monilial infection of the skin. Report of a fatal case, *Arch. Derm. Syphilol.* 29: 574-584, *6 figs.*

Roger, Henri. 1896. Modification du sérum chez les animaux vaccinés contre l'Oidium albicans, *C. R. Soc. Biol.* 48: 728-730.

—. 1921. Langue noire pileuse, *Gaz. Hôp. Civ. Milit.* 94: 1269, 1270.

Roger, Henri, & P. Émile Weil. 1904. Contribution à l'étude des adénomes. Une nouvelle saccharomycose expérimentale chez le lapin, *Arch. Med. Exp.* 16: 145-162, *Pls. 4, 5.*

Rogers, J. M. 1922. Isolation of Monilia psilosis in tropical sprue (psilosis). Report of a case that originated in Korea, *Jour. Amer. Med. Ass.* 79: 1677, 1678.

Rogers, James B. & Franklin Jelsma. 1933. Torula Meningo-encephalitis, *Jour. Amer. Med. Ass.* 100: 1030, 1031, *2 figs.*

Rogers, Leonard. 1918. Four years further experience of autogenous oral streptococcal vaccines in the treatment of seventeen cases of sprue, *Indian Med. Gaz.* 53: 121-126.

Roncali, D. B. 1895. Die Blastomyceten in den Adeno-carcinomen der Ovariums II, *Centralbl. Bakt.* 18: 353-368.

—. 1895. Die Blastomyceten in den Sarkomen, *Centralbl. Bakt.* 18: 432-434.

—. 1895. Sopra particolari parassiti rinvenuti di un adenocarcinoma (papilloma infettante) della ghiandola ovarica, *Policlinico, Sez. Chirurg.* 2: 182-192, *1 pl.*

—. 1895. I blastomiceti nei sarcomi, *Policlinico, Sez. Chirurg.* 2: 484, 485.

—. 1895. Intorno all'esistenza de'fermenti organizati ne'sarcomi. Memoria IV sopra l'etiologia de'neoplasmi maligni, *Centralbl. Bakt.* 20: 726-744.

—. 1896. Di un nuovo blastomiceto isolato da un epitelioma della lingua e dalle metastasi ascellari di un sarcoma della ghiandola mammaria, patogeno per gli animali e molto simile per il suo particolare modo di degenerare ne' tessuti delle cavie al Saccharomyces lythogenes del Sanfelice. Contributo all'etiologia de'neoplasmi maligni, *Centralbl. Bakt.* 20: 481-488.

—. 1897. Ricerche microbiologiche di un tumore addominale, *Riforma Med.* 13: 1: 616, 617, 626-628.

—. 1897. Über den gegenwärtigen Stand unserer Kenntnisse über Aetiologie des Krebses, *Centralbl. Bakt.* I, 21: 318-325; 394-399.

—. 1898. Klinische Beobachtungen und histologische und mikrobiotische Untersuchungen über einen Fall von primären Adenocarcinom (Papiloma infectans) des Colon transversum und descendens mit sekundären Uebergang auf das grosse Netz und das Mesenterium, *Centralbl. Bakt.* I, 24: 61-69, 158-165, 212-234, 306-315, 353-359, *2 pls.*

—. 1898. On the existence of blastomycetes in adenocarcinomata and sarcomata and the peculiar process of their degeneration in neoplastic tissues, *Jour. Path. Bact.* 5: 1-12, *Pls. 1-3.*

Rossi-Doria, Tullio. 1895. La teoria blastomicetica del cancro, *Policlinico, Sez. Chirurg.* 2: 486-496.

—. 1896. I blastomiceti nel sarcoma puerperale infettante, *Policlinico, Sez. Chirurg.* 3: 91-96, *Pl. 1.*

Rotter, Werner & Antonio Peña Chavarría. 1933. Untersuchungen über Blastomykosen in Costa Rica, *Arch. Schiffs u. Tropen-Hyg.* 37: 1-10, *14 figs.*

—. 1934. Weitere Untersuchungen über Blastomykosen in Costa Rica, *Arch. Schiffs. u. Tropenhyg.* 38: 406-417, *11 figs.*

Roux, Gabriel. 1889. Le champignon de muguet, *Lyon Méd.* 62: 307, 308.

Roux, Gabriel & Georges Linossier. 1889. Sur la mycose expérimentale due au champignon du muguet, *Lyon Méd.* 62: 327-330.

—. 1890. Recherches morphologiques sur le champignon du muguet, *Arch. Méd. Exp.* 2: 62-87, *10 figs.* [See also *Ibid.* 2: 222-252.]

Rouyer, E. & J. Pellissier. 1915. Contribution à l'étude de certaines mycoses de blessures de guerre et de leurs traitements, *Ann. Inst. Pasteur* 29: 551-555.

Ruete, Alfred. 1928. Pityriasis versicolor, *Handbuch d. Haut- u. Geschlechtskrankh.* [Jadassohn] 11: 696-710, *5 figs.*

Rusk, Glanville Y. & Frederick J. Farnell. 1912. Systemic oidiomycosis: a study of two cases developing terminal oidiomycetic meningitis, *Univ. California Publ. Path.* 2: 47-58, *Pl. 1.*

Russell, William. 1899. The parasite of cancer, *Lancet* 1: 1138-1141.

Ryfkogel, H. A. L. 1910. Coccidioidal meningitis with secondary internal hydrocephalus and death (anaphylactic?) following a second injection of Flexner's serum, *Jour. Amer. Med. Ass.* 55: 1730-1732.

—. 1913. Coccidioidal granuloma in California, *Jour. Amer. Med. Ass.* 60: 308.

Sabouraud, Raimond. 1923. La question des intertrigo mycoses (á propos du rapport de M. Petges au congrès récent des dermatologistes de langue française), *Ann. Derm. Syphiligr.* VI, 4: 425-432.

*Sacamo. 1921. Ricerche sulla biologie della Monilia bronchialis, *Studium* :350.

Salvat, Pax & Maurice Fontoynont. 1922. Contribution à l'étude des mycoses malgaches: abcès sous-dermiques dus à l'Endomyces Molardi (n. sp.), *Bull. Soc. Path. Exot.* 15: 311-320.

Šamberger, Fr. 1904. Dermatitis blastomycetica *Sborník Klinický* [*Arch. Bohêmes Med. Clin.*] 5: 466-485, *Pl. 6.*

Samson. 1922. Mitteilungen zur Morphologie und zum biologischen Verhalten der bei der Erosio interdigitalis blastomycetica gezüchteten Hefepilze, *Derm. Woch.* 76: 473-481.

Sanderson, Everett S. & Dudley C. Smith. 1930. The effect of gentian violet on the organism of blastomycotic infection, *Arch. Derm. Syphilol.* 16: 153-155.

Sanfelice, Francesco. 1895. Sull'azione patogena dei blastomiceti come contributo alla etiologia dei tumori maligni, *Policlinico, Sez. Chirurg.* 2: 204-211.

—. 1895. Sull'azione patogena dei blastomiceti I, *Ann. Ig. Sperim.* 5: 239-262, *Pls. 9, 10.*

—. 1895. Ueber eine für Thiere pathogene Sprosspilzart, und über die morphologische Uebereinstimmung, welche sie bei ihrem Vorkommen in die Gewebe mit den vermeintlichen Krebscoccidien zeigt, *Centralbl. Bakt.* 17: 113-118.

—. 1895. Ueber die pathogene Wirkung der Sprosspilzer zugleich ein Beitrag zur Ätiologie der bösartigen Geschwülste, *Centralbl. Bakt.* 17: 625-634.

—. 1895. Ueber einen neuen pathogenen Blastomyceten welcher innerthalb der Gewebe unter Bildung kalkartig aussehender Massen degeneriert, *Centralbl. Bakt.* 18: 521-526.

—. 1896. Ueber die Immunität gegen Blastomyceten, *Centralbl. Bakt.* 20: 219-222.

—. 1898. Ein weiterer Beitrag zur Aetiologie der bösartigen Geschwülste, *Centralbl. Bakt.* 24: 155-158.

—. 1906. Ueber die pathogene Wirkung der Blastomyceten. Ein Beitrag zur Ätiologie des sogenannte Farcinus cryptococcicus, *Zeitschr. Hyg.* 54: 299-326, *Pl. 9.*

Sanfilippo, Emanuele. 1924. Moniliasi broncho-polmonari, *Ann. di Clin. Med. Med. Sperim.* 14: 441-476.

Sangiorgi, Giuseppe. 1912. Beitrag zur Kenntnis der pathologischen Blastomykose, *Centralbl. Bakt.* I, 63: 58-62.

[Santori.] 1903. Sopra un nuovo blastomicete patogeno Saccaromyces infiltrans Casagrandi et Santori, Sacc. pseudotubercolaris Santori, *Riforma Med.* 19: 281-283.

*Sarramon, & R. Pons. 1924. Tumeur mycosique de la face interne de la joue chez un annamite, *Bull. Soc. Méd. Chirurg. Indochine* 2: 96, 97.

Sartory, Antoine. 1907. Étude bibliographique et biologique de l'Oidium lactis, *Bull. Soc. Myc. France* 23: 39-49.

—. 1920. Contribution à l'étude bactériologique de la langue noire pileuse, *Bull. Acad. Méd. Paris* III, 83: 532, 533.

Sartory, Antoine & Ph. Lasseur. 1915. Étude d'une nouvelle levure pathogène, *C. R. Soc. Biol.* 78: 48, 49.

—. 1916. Étude d'une nouvelle levure pathogène: Saccharomyces Lemonnieri n. sp., *Bull. Sci. Pharmacol.* 23: 151-157, *1 fig.*

Sartory, Antoine & L. Moinson. 1922. Un cas de moniliase bronchique, *C. R. Acad. Sci.* 174: 77-79.

Sartory, Antoine & A. Orticoni. 1914. Étude d'une levure (Cryptococcus) et d'un Oidium rose isolés de la bouche, *Rev. Path. Comp.* 14: 174-176.

Sartory, Antoine, G. Petges & Claqué. 1923. Laryngite chronique pseudo-tuberculeuse d'origine mycosique due à une levure nouvelle Cryptococcus laryngitidis, n. sp., *C. R. Soc. Biol.* 84: 179, 180.

Sartory, Antoine, R. Sartory, G. Hufschmitt & Jacques Meyer. 1930. Une mycose nouvelle provoquée par une levure du genre Debaryomyces: Debaryomyces mucosus n. sp., *C. R. Acad. Sci.* 191: 281-283.

—. 1930. Étude d'un Cryptococcus nouveau (Cryptococcus corallinus) isolé de lésions rappelant les kérions trichophytiques, *C. R. Soc. Biol.* 104: 1316-1318.

Sartory, Antoine, R. Sartory & Jacques Meyer. 1931. Étude botanique et biologique d'une nouvelle levure rose (Cryptococcus radiatus n. sp.), *C. R. Soc. Biol.* 106: 597, 598.

—. 1931. Épidermomycose provoquée par une levure, *C. R. Soc. Biol.* 106: 599, 600.

Sartory, Antoine, R. Sartory, Jacques Meyer and Charles. 1931. Un nouveau Mycoderma pathogène: Mycoderma nobile n. sp., *Ann. Myc.* 29: 325-338, *6 figs.*

Sartory, Antoine, R. Sartory, F. Sternon & Jacques Meyer. 1932. Une dermatomycose causée par une levure nouvelle de genre Saccharomyces; Saccharomyces Sternoni n. sp., *Bull. Acad. Méd. Paris* III, 107: 120, 121.

Sartory, Antoine, R. Sartory, J. Weill & Jacques Meyer. 1932. Un cas de blastomycose invéterée transmissible au cobaye due à un Saccharomyces pathogène (Saccharomyces Jadini n. sp.), *C. R. Acad. Sci.* 194: 1688-1690.

Sasakawa, Maseo. 1922. Zur Systematik pathogener und parasitischer Hefen. Morphologisch-biochemische Studie, *Centralbl. Bakt.* I, 88: 269-285, *1 pl.*

*Savchenko, J. G. 1898. Les sporozoaires des tumeurs malignes et les blastomycètes pathogènes, *Russkii Arkh. Patol. Klin. Med. Bact.* 5: [Rev. in *Baumgarten's Jahresber.* 14: 654.]

Schaechter, Iliazar Israël. 1901. De la trichosporie (piedra nostras et piedra columbica), *Thèse Méd. Nancy* 19: 56 pp., *2 pls.*

Schaede, Reinhold. 1934. Über zwei neue Oosporaarten bei schwarzer Haarzunge, *Derm. Woch.* 98: 521-527.

Schamberg, Jay Frank. 1915. [Memorandum on cutaneous thrush], *Arch. Pediatr.* 32: 617-620.

*Schiessleder, P. 1924. Beiträge zur Züchtung und Desinfektion des Soorpilzes, *München. Tierärztl. Woch.* 75: 29.

Schilling, Rudolf. 1908. Über experimentelle, endogene Infektion der Nase und des Ohres durch pathogene Hefen, *Zeitschr. Ohrenheilk.* 56: 61-77, *Pls. 5-7.*

Schmidt, Martin B. 1890. Über die Localisation des Soorpilzes in den Luftwegen und sein Eindringen in das Bindegewebe der Oesophagus Schleimhaut, *Beitr. Path. Anat. Allg. Path.* [Ziegler] 8: 173-187, *Pl. 11.*

*Schmitt. 1852. Über den Soor der Kinder. *Inaug. Diss. Würzburg.*

Schmitter, Ferdinand. 1923. The aetiological fungi of tinea versicolor and tinea flava, *Jour. Trop. Med. Hyg.* 26: 190-194.

Schmorl, G. 1890. Ein Fall von Soormetastase in der Niere, *Centralbl. Bakt.* 7: 329-335.

Schönlein. 1839. Zur Pathologie der impetigines, *Arch. Anat. Phys. Wiss. Med.* [Müller], 1839: 82.

Schramek, Max. 1916. Befunde bei Pilzerkrankungen der Hände und Füsse, *Arch. Derm. Syphilis* 121: 630-645, *illust.*

Schultz, Frederick W. 1925. Two cases of thrush with unusual symptoms and skin manifestations, *Am. Jour. Dis. Child.* 29: 283.

Schwartz, Hans J., John C. Torrey & J. Frank Fraser. 1931. Intestinal flora in psoriasis, *Arch. Derm. Syphilol.* 23: 70-73.

Scott, J. A. 1927. Oidiomycosis of nails, *Brit. Jour. Derm. Syphilis* 39: 119-122, *2 figs.*

Secchi, Thomas. 1897. Über die pathogene Wirkung der Blastomyceten und ihre Bedeutung in der Ätiologie der Neubildungen und andere Krankheiten, *Monatsh. Prakt. Derm.* 25: 68-78, 109-126 [tr. by C. Müller].

*Seeber, G. R. 1900. Un nuevo esporozoario parásito del hombre, dos casos encontrados en pólipos nasales, *Tesis, Fac. Méd. Univ. Buenos Aires,* 62 pp., *3 pls.*

*—. 1912. Rhinosporidium Kinealyi et Rhinosporidium Seeberi, une question de priorité. Buenos Aires, 19 pp., *3 pls.*

Seiler, S. 1932. Beitrag zur Kenntnis der pathogenen Hefen, *Centralbl. Bakt.* I, 126: 404-414, *10 figs.*

*Selenew. 1908. Onychia blastomycetica, *Russ. Zeitschr. Hyg. Vener. Krankh.* 16.

Semerak, C. B. 1928. Torular leptomeningitis, *Arch. Path.* 6: 1142-1145.

*Seminario, C., J. Pessano & Pablo Negroni. 1930. Blastomicosis generalizada de comienzo bucal propaganda al sistema linfático y a los pulmones, *Rev. As. Argentina Derm. Sif.* 5.

Sequeira, James H. 1903. A case of blastomycosis, *Brit. Jour. Derm. Syphilis* 15: 121-125, *2 pls.*

Serra, Américo. 1929. The relation of sprue to pernicious anaemia with a report on blood changes in 45 cases of sprue, *Am. Jour. Trop. Med.* 9: 49-65.

Servet, Ch. F. A. 1922. Les blastomycoses pulmonaires, *Rev. Méd. de l'Est.* 50: 364-370.

—. 1922. Contribution à l'étude des blastomycoses pulmonaires, *Thèse Méd. Nancy,* 108 pp.

Shapiro, Louis L. & Josephine B. Neal. 1925. Torula meningitis, *Arch. Neur. Psych.* 13: 174-190, *8 figs.*

Shaw, Frederick W. 1926. A new species of Monilia pathogenic for man, *Science* 64: 300.

—. 1927. A Monilia from the respiratory tract, *Jour. Lab. Clin. Med.* 12: 968-972.

—. 1928. The classification of the genus Monilia, *Amer. Nat.* 62: 478, 479.

—. 1931. A morphological study of the genus Monilia, *Centralbl. Bakt.* I, 119: 460-464.

Shelmire, Bedford. 1925. Thrush infection of the skin, *Arch. Derm. Syphilol.* 12: 789-813.

Shepherd, Francis. 1902. Two cases of blastomycetic dermatitis, one of which was cured by iodid of potassium, *Jour. Cut. Gen.-Urin. Dis.* 20: 158-163, *3 figs.*

Sheppe, W. M. 1924. Torula infection in man, *Am. Jour. Med. Sci.* 167: 91-108.

Shrewsbury, J. F. D. 1930. The genus Willia, *Jour. Path. Bact.* 33: 393-416, *Pls. 42-46.*

—. 1933. Rhinosporidiosis, *Jour. Path. Bact.* 36: 431-434, *Pls. 47-50.*

Silva, Flaviano. 1923. Intertrigo saccharomycetico, *Brasil Med.* 37: 2:119-127, *5 figs.*

Silverman, Daniel M. 1927. Sprue: extended studies with especial reference to pancreatic digestion, *Southern Med. Jour.* 20: 762-765.

Simon, Sidney K. 1921. Some observations on sprue and its prevalence in the South, *Southern Med. Jour.* 14: 255-260.

Skchiwan. 1899. Contribution à l'étude du sorte des levures dans l'organisme, *Ann. Inst. Pasteur* 13: 770-777.

Skolnik, Edward A. 1930. Perlèche of adults, a report of five cases apparently of mycotic origin, *Arch. Derm. Syphilol.* 22: 642-646.

*Sluyter. 1847. De vegetabilibus organismi animalis parasitis ac de novo epiphyto in pityriasi versicolore obvio, *Diss. Inaug. Berlin.*

*Smidt, F. P. G. de. 1927. A type of Monilia in a case of suspected pulmonary tuberculosis in a European, *Kenya Med. Jour.* 3: 272-274.

Smith, D. C., H. C. Turner and E. S. Sanderson. 1928. Systemic blastomycosis with report of a fatal case, *Brit. Jour. Derm. Syphilis* 40: 344-359, *7 figs.* on plates.

Smith, E. C. 1927. Dermal moniliases among natives of West Africa, *Trans. R. Soc. Trop. Med. Hyg.* 21: 125-130, *8 pls.*

—. 1927. Prickly heat: its aetiology and pathology, *Trans. R. Soc. Trop. Med. Hyg.* 20: 344-351, *9 pls., 30 figs.*

—. 1928. Moniliasis linguae, *Jour. Trop. Med. Hyg.* 31: 101, 102, *3 figs.*

—. 1928. Tinea flava (Castellani), *Jour. Trop. Med. Hyg.* 31: 169-173, *12 figs.*

Smith, F. B. & J. S. Crawford. 1930. Fatal granulomatosis of the central nervous system due to a yeast (Torula), *Jour. Path. Bact.* 33: 291-296, *Pls. 26, 27.*

Smith, Lawrence Weld. 1924. Monilia psilosis Ashford in severe anemia associated with the sprue syndrome, *Philippine Jour. Sci.* 29: 447-465, *1 pl.*

—. 1924. The rôle of Monilia psilosis (Ashfordi) in experimental sprue, including mycologic observations on twenty-one strains of Monilia, *Jour. Amer. Med. Ass.* 83: 1549-1554, *5 figs.*

Smith, Lawrence Weld & Machteld E. Sano. 1933. Moniliasis with meningeal involvement, *Jour. Infect. Dis.* 53: 187-196, *2 figs.*

Snoke, John H. & E. J. Strick. 1912. A case of suspected pulmonary blastomycosis, *China Med. Jour.* 26: 280-283.

Souza Campos, Ernesto de & Floriano Paulo de Almeida. 1927. Contribuição para o estudo das blastomycoses (Granuloma coccidioides) observadas em São Paulo, *Annaes Fac. Med. São Paulo* 2: 203-220, *21 figures on unnumbered plates.*

Spaar, Eric C. 1926. A brief note on the biochemical reactions of certain fungi, viz. Monilia Krusei, M. macedoniensis and M. tropicalis, *Jour. Trop. Med. Hyg.* 29: 47, 48.

Spencer, H. A. 1931. Pulmonary conditions associated with malaria and bronchomycoses, *Jour. Trop. Med. Hyg.* 34: 106-108.

Speroni, David, Joaquín Llambías, Silvio E. Parodi & Flavio L. Niño. 1930. Blastomicosis humana generalizada por criptococo [n. sp.]. Estudio parasitológico, anátomopatológico, clínico y experimental, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 94-155, *35 figs.* [*5ta Reunión Soc. Argent. Patol. Reg. del Norte, Jujuy,* 1929.]

Spiethoff, [Anton Gustav] Bodo. 1904. Klinische und experimentelle Studien über Blastomykose, *Jahrb. Hamburg. Staatskrankenanst.* 9: 167-208, *Pls. 14, 15.*

Splendore, Alfonso. 1909. Sobre un caso de blastomycose generalizada, *Rev. Soc. Sci. São Paulo.* 4: 52.

*—. 1910. Blastomicosi americaine, *Boll. Soc. di Med. e d'Ig. Col.* 2.

—. 1911. Buba-blastomicosi-Leishmaniosi, *Arch. Schiffs u. Trop. Hyg.* 15: 105-113. Also Buba-blastomicosi-Leishmaniosi. Nota sopra affezioni framboesiche osservate in Brasile, *Policlinico, Sez. Chirurg.* 18: 30-37.

—. 1912. Zymonematosi con localizzazione nella cavità della bocca osservata in Brasile, *Bull. Soc. Path. Exot.* 5: 313-319. [*. . . determinata da funghi appartenenti alla tribu degli Exoascei (Zymonema brasiliense n. sp.), *Angelo Celli Festschrift.*]

Spring, Dorothy. 1929. Comparison of seven strains of organisms causing blastomycosis in man, *Jour. Infect. Dis.* 44: 169-185.

Srebrny, Siegmund. 1904. Soor bei gesunden Erwachsenen, *Arch. Laryngol. Rhinol.* 16: 36-42.

Stäheli, E. 1921. Drei Fälle von Hautentzündung verursacht durch Oidien (Dermatitis pustulosa oidiomycetica), *Arch. Derm. Syphilis* 134: 407-417.

Staehelin, A., Jui-wu Mu & M. van Schouwen. 1932. Beiträge zur Klinik und Pathogenese der Oidiomykosen, *Arch. Derm. Syphilis* 165: 294-342.

Stansfield, Oliver H. 1921. A case of bronchial asthma possibly due to a Sporothrix, *Boston Med. Surg. Jour.* 185: 659.

Steinert, Ernst. 1920. Zur Klinik der Soorkrankheit und zur Biologie des Soorpilzes, *Zeitschr. Kinderheilkrankh.* 25: 83-103, *20 figs.*

Stelling-Dekker, N. M. (see Dekker, N. M. Stelling-)

Stelwagon, Henry W. 1901. Report of a case of blastomycetic dermatitis, *Amer. Jour. Med. Sci.* 121: 176-183.

Stephan, Siegfried. 1925. Über die Soorkolpitis und ihre Behandlung, *Monatschr. Geburtsh. Gynäk.* 69: 65-69, *Pl. 1.*

Sternberg, Carl. 1902. Experimentelle Untersuchungen über pathogene Hefen, *Beitr. Path. Anat. Allg. Path.* 32: 1-106, *Pls. 1-3.*

Stickel, Johannes. 1921. Zur Frage der Erosio interdigitalis blastomycetica, *Derm. Woch.* 72: 257-264.

*Stiles, G. W., M. S. Shahan & C. L. Davis. 1933. Coccidioidal granuloma in cattle in Colorado, *Jour. Amer. Vet. Med. Ass.* 82: 928-930.

Stober, A. M. 1914. Systemic blastomycosis, *Arch. Intern. Med.* 13: 509-556, *26 figs.*

Stock, W. 1908. Über experimentelle hämatogene Erkrankungen des Auges und seiner Adnexe beim Kaninchen durch pathogene Hefen (Busse und Klein), *Beitr. Path. Anat.* 43: 470-483, *3 figs.*

Stoddard, James L. & Elliott C. Cutler. 1916. Torula infection in man, *Rockefeller Inst. Med. Res. Monog.* 6: 1-98, *9 pls.*

Stoecklin, Henry de. 1898. Recherches cliniques et experimentales sur le rôle des levures trouvées dans les angines suspectes de diphthérie, *Arch. Méd. Exp. Anat. Path.* 10: 1-41.

Stoewer. 1899. Über die Wirkung pathogener Hefen am Kaninchenauge, *Arch. Ophthalm.* 48: 178-191, *Pl. 7.*

Stone, Kenneth & L. P. Garrod. 1931. The classification of Monilias by serological methods, *Jour. Path. Bact.* 34: 429-436.

Stone, Willard J. & B. F. Sturdivant. 1929. Meningo-encephalitis due to Torula histolytica, *Arch. Int. Med.* 44: 560-575, *9 figs.*

Stovall, W. D. & Anna A. Bubolz. 1932. Cultural and biochemical characteristics of Monilia isolated from human sources, *Jour. Infect. Dis.* 50: 73-88, *3 figs.*

—. 1933. Yeast-like fungi, *Jour. Lab. Clin. Med.* 18: 890-902, *7 figs.*

Stovall, W. D. & Hugh P. Greeley. 1928. Bronchomycosis. Report of eighteen cases of primary infection in the lung, *Jour. Amer. Med. Ass.* 91: 1346-1351, *8 figs.*

Strong, Richard P. 1906. A study of some tropic ulcerations of the skin with practical reference to their etiology, *Philippine Jour. Sci.* 1: 91-115, *14 pls.*

Stryker, G. V. 1927. Study of yeast-like organisms of Erosio digitalis, *Southern Med. Jour.* 20: 851-854, *2 figs.*

Sur, Taraknath. 1921. Bronchomoniliasis, *Indian Med. Gaz.* 56: 445-449, *2 pls., 1 fig.*

Sutherland-Campbell, H. 1929. Paronychia, an attempt to prove the etiologic factor in an epidemic among orange workers, *Arch. Derm. Syphilol.* 19: 233-254, *19 figs.*

Swartz, J. H. 1928. Chronic paronychia, *Arch. Derm. Syphilol.* 18: 74-78, *5 figs.*

Swift, Harry & Lionel B. Bull. 1917. Notes on a case of systemic blastomycosis-blastomycotic cerebrospinal meningitis, *Med. Jour. Australia* 4: 2:265-267, *1 fig.*

Takahashi, S. 1929. Über die Soormykose der Haut. I, *Jap. Jour. Derm. Urol.* **29**: 224-251 [26-31]. II, Ueber die Sprosspilze aus den Stuhle des Menschen, *Ibid.* **29**: 318-330.

—. 1933. Experimentelle Untersuchungen über Coccidioides immitis, *Arch. Derm. Syphilis* **168**: 597-610, *6 figs.*

Talice, Rodolfo V. 1930. Sur la filamentisation des Monilia, *Ann. Parasitol. Hum. Comp.* **8**: 394-410.

Talice, Rodolfo V. & Juan E. Mackinnon. 1928. Estudio de algunas Monilias de los esputos. Consideraciones sobre micosis pulmonares, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* **4**: 502-519. [*4ta Reunión Soc. Argent. Pat. Reg. del Norte, Santiago del Estero,* 1928.]

—. 1932. La valeur du voile des cultures en milieu liquide pour la classification des champignons levuriformes (Mycotorulées), *C. R. Soc. Biol.* **111**: 534, 535.

—. 1933. Observaciones sobre algunos hongos levuriformes (Micotoruleas), aislados en Montevideo, *Arch. Soc. Biol. Montevideo* **5**: [1-4].

—. 1933. Primer caso de blastomicosis (tipo Gilchrist) observado en el Uruguay, agente patógeno Micotorula albicans (Ch. Robin 1853), *Arch. Uruguayos Med. Cirúrg. Especialidades* **3**: 177-203, *11 figs.*

—. 1933. Qué es ''Monilia albicans''? *Arch. Soc. Biol. Montevideo* **5**: [1-5].

Tanaka, Takehiko. 1920. A Saccharomyces in mesenteric glands of the human body, *Jour. Path. Bact.* **23**: 350-355, *Pl. 18.*

Taniguchi, Yoshiakira. 1926. Experimentelle Studie über ''Erosio interdigitalis blastomycetica'' besonders über diejenigen bei den Papierarbeitern in der Provinz Gifu (Sadare Krankheit), *Jap. Jour. Med. Sci.* XIII, *Derm. Urol.* **1**: 74-94, *Pls. 1, 2.*

Tannenberg, Joseph. 1923. Doppelseitige Soorerkrankung des Nierenbeckens bei einem Diabetiker, *Zeitschr. Urol.* **17**: 82-105, *Pl. 1, 2 figs.*

Tanner, Fred W. & G. M. Dack. 1924. A study of the yeasts from sore throat, *Centralbl. Bakt.* I, **91**: 282-299.

Tanner, Fred W., Ester N. Lampert & M. Lampert. 1927. On the presence of yeast-like fungi in normal throats, *Centralbl. Bakt.* I, **103**: 94-97.

Tanner, Fred W. & Bertram Feuer. 1920. Culture studies on an infection of the skin by Endomyces albicans, *Arch. Derm. Syphilol.* **1**: 365-369, *3 figs.*

Tarchini, P. 1926. Sopra un caso di blastomicosi cutanea, *Giorn. Ital. Derm. Sifilol.* **67**: 263-278, *5 pls.*

Tarentelli, Eugenio. 1933. Onychie und Paronychie durch Pilze vom Typus ''yeast-like.'' Ihre pathogenetische Bedeutung [tr. Heinz Rangenhofer] *Derm. Woch.* **97**: 1311-1319; 1346-1353, *Figs. 1-9.*

*Tartakowsky, M. D. 1897. Der afrikanische Rotz der Pferde. St. Petersburg.

Taubert, Walther. 1922. Heilversuche bei Lymphangitis epizootica, abszedierender Phlegmone, sowie bei Wunden durch phytotherapeutische Behandlung mit vergleichender Schilderung der Eigenblutbehandlung, *Inaug. Diss. Tierärztl. Hochschule Dresden,* 35 pp.

Taylor, Raymond G. 1923. Coccidioidal granuloma, *Amer. Jour. Roentgenol.* **10**: 551-558, *25 figs.*

Teissier, P. 1895. Sur un cas d'angine pseudomembraneuse observée chez une syphilitique avec présence exclusive dans l'exsudat des formes levures du muguet, *Arch. Méd. Exp. Anat. Path.* **7**: 265-273.

—. 1897. Contribution à l'étude du champignon du muguet, *Arch. Méd. Exp. Anat. Path.* **9**: 253-276.

Templeton, H. J. 1926. A study of dandruff and of Pityrosporon of Malassez, *Arch. Derm. Syphilol.* **14**: 270-279, *4 figs.*

Terra, Fernando. 1923. Tres casos de Blastomycose. Ligeiros commentarios, *Brasil Med.* **37**: 1:41-44, *2 figs.*

Terra, Fernando, d'Utra e Silva & Arthur Moses. 1918. Casos de piedra, *Brasil Med.* **32**: 37.

Thienes, C. H. 1929. A new Monilia-like fungus characteristic of an organism associated with a dermatosis peculiar to workers in canneries, *Arch. Derm. Syphilol.* **19**: 800-806, *4 figs.*

Thiroloix, J. & Loufcarde-Cortina. 1923. Mycose évoluant comme une carcinomatose subaigue, *Bull. Mém. Soc. Méd. Hôp. Paris* **39**: 1320-1324.

Thiry, G. 1912. Muguet spontané chez le singe, langue pileuse brune, *Arch. de Parasitol.* **16**: 168-176.

Thomas, Erwin. 1921. Über einige Wirkungen der Soorbestandteile, *Jahrb. Kinderheilk.* **96**: 95-100.

Thorne, W. S. 1894. A case of protozoic skin disease, *Occident. Med. Times* **8**: 703, 704.

Tieghem, Philippe van. 1887. Oleina et Podocapsa, deux genres nouveaux de l'ordre des Ascomycètes, *Jour. de Bot.* [Morot] **1**: 289-296, *2 figs.*

*Timpano, M. 1930. Osservazioni sul granuloma Coccidioides immitis, *Boll. Soc. Mea. Chirurg. Pavia* **6**: 681.

Tirumurti, T. S. 1914. Rhinosporidium kinealyi, *Practitioner* **93**: 704-719, *Pls. 14-16.*

Toepel, Theodore. 1929. Systemic blastomycosis, *Jour. Am. Med. Ass.* **93**: 32.

Tokishige, H. 1896. Über pathogene Blastomyceten, *Centralbl. Bakt.* I, **19**: 105-113, *Pls. 3-5.*

Tommasoli, P. 1889. Flora dermatologica Bacillen, Kokken und Hefeformen, *Monatsh. Prakt. Derm.* **9**: 49-61.

Tomlinson, C. C. & Paul Bancroft. 1928. Granuloma coccidioides. Further observations on the use of antimony and potassium tartrate and the roentgen rays in treatment; report of an additional case, *Jour. Am. Med. Ass.* **91**: 947-951.

—. 1934. Granuloma coccidioides, *Jour. Am. Med. Ass.* **102**: 36-38, *3 figs.*

Tordeus, Edouard. 1882. Essai sur le muguet du nouveau-né. Thèse d'Agrégation. Bruxelles H. Manceau, 123 pp.

Touraine, & F. Desvaux. 1923. Contribution à l'étude des épidermomycoses à levures et à champignons levuriformes, *Thèse de Paris* **203**: 1-55.

Trachsler, Willy. 1896. Über die feineren Unterscheide zweier Fälle von Piedra nostras, *Monatsh. Prakt. Derm.* **22**: 1-10, *1 pl.*

Treuherz, Walter. 1929. Echte und falsche Blastomycose, *Derm. Woch.* **89**: 984-995.

Troester, C. 1920. Zur Diagnose der Lymphangitis epizootica der Einhufer mittels der Dunkelfelduntersuchung, *Berlin. Tierärztl. Woch.* **36**: 138.

Troisier, E. & P. Achalme. 1893. Sur une angine parasitaire causée par une levure et cliniquement semblable à muguet, *Arch. Méd. Exp.* **5**: 29-37.

Türck, Wilhelm. 1907. Ein Fall von Hefeinfektion (Saccharomykose) der Meningen, *Deutsch. Arch. Klin. Med.* **90**: 335-366, *Pl. 8.*

Turpin. 1838. Mémoire sur la cause et les effets de la fermentation alcoolique et acéteuse, *Mém. Acad. Sci.* n. s. **17**: 1-88, *Pls. 1-9.*

Unna, P. G. 1895. Über Piedra nostras, *Deutsch. Med. Zeitung.* **1895**: 255, 256.

Urbach, Erich & Franz Zach. 1930. Generalisierte Torulose (Europäische Blastomykose). Eine klinisch-botanisch Studie, *Arch. Derm. Syphilis* **162**: 401-421, *11 figs.*

Valentin. 1888. Ein Fall von Soor des Mittelohres, *Arch. Ohrenheilk.* **26**: 81-83.

Van Hoorn, W. 1895. Über Mikroorganismen bei Seborrhoea, *Monatsh. Prakt. Derm.* **20**: 545-549.

Vélu, H. 1924. La blastomycose des voies lacrymales de l'âne et son inoculabilité, *Bull. Soc. Path. Exot.* **17**: 545-547.

Verity, Roger. 1912. Contributo allo conoscenza dell'intima struttura dei blastomiceti, *Sperim.* **66**: 1-32, *7 figs.*

Verkaik, C. 1931. Über die Hefegattung Schizotorulopsis Ciferri, *Centralbl. Bakt.* II, **85**: 153-155.

Verona, Onorato. 1933. Sulla sistematica delle Mycotorulcae Cif. et Red, *Nuovo Giorn. Bot. Ital.* n. s. **40**: 225-229.

Versé. 1914. Über einen Fall von generalisierter Blastomykose beim Menschen, *Zentralbl. Path.* 25: 408.

Vívoli, Donato, Ramón Avellaneda & Esther de Bardessi. 1932. Glositis ulcerosa por Monilia argentina (n. sp.), *Reunión Soc. Argent. Patol. Reg. del Norte, Tucumán.* 7: 239-277, *37 figs.*

Vlaeff. 1899. Nature des blastomycètes pathogènes, *Bull. Soc. Anat.* V, 74: 766-768.

Voss, J. A. 1923. Et tilfaelde av generel blastomykose, forløpende under billedet av en meningit, *Norsk. Mag. Laegevidensk.* 84: 550-560.

Vuillemin, Paul. 1898. Les caractères spécifiques du champignon du muguet (Endomyces albicans), *C. R. Acad. Sci.* 127: 630-633.

—. 1899. Les formes du champignon du muguet, *Rev. Myc.* 21: 43-55, *Pls. 189, 190.*

—. 1900. Cancer et tumeurs végétales, *Bull. Séances Soc. Sci. Nancy* III, 2: 37-62.

—. 1901. Les blastomycètes pathogènes, *Rev. Gén. Sci.* 12: 732-751.

—. 1901. Un cas de Trichosporie (Piedra nostras) observé en France, *C. R. Acad. Sci.* 132: 1369-1371.

—. 1902. Trichosporum et trichospories, *Arch. de Parasitol.* 5: 38-66, *12 figs.*

—. 1911. Différence fondamentale entre le genre Monilia et les genres Scopulariopsis, Acrosporium et Catenularia, *Bull. Soc. Myc. France* 27: 137-152.

Vuillemin, Paul & E. Legrain. 1900. Sur un cas de Saccharomycose humaine, *Arch. de Parasitol.* 3: 237-268.

Wachowiak, M. & Moyer S. Fleischer. 1926. Epidermomycosis of the sole caused by Monilia and yeast, *Arch. Derm. Syphilol.* 13: 815-818.

Wachowiak, M., G. V. Stryker, J. Marr, H. Bock and Moyer S. Fleischer. 1929. The occurrence of Monilia in relation to psoriasis, *Arch. Derm. Syphilol.* 19: 713-731.

Wade, H. Windsor. 1916. A variation of gemmation of Blastomyces dermatitidis in the tissue lesion, *Jour. Infect. Dis.* 18: 618-629, *Pl. 22, 23.*

Wade, H. Windsor & George S. Bel. 1916. A critical consideration of systemic blastomycosis with notes on certain special features and report of five cases, *Arch. Int. Med.* 18: 103-130.

Wallace, G. I. & Fred W. Tanner. 1927. An etiologic agent in bronchomycosis, *Amer. Rev. Tuberculosis* 15: 373-379.

Watanabe, K. 1927-1928. Die chromolytische Studie der Hefe. I. Der chemische Aufbau der Hefe, *Jap. Jour. Derm. Urol.* 27: 373-385. [27-33] 1927. II. Über freie Fette und Fettarten, *Ibid.* 27: 735-747. [57-59] III. Über die Hefealbumose und Grobuline, *Ibid.* 27: 945-959. [68-72] IV. Die Zuckerarten der Hefe, *Ibid.* 28: 521-532 [29-33], 1928.

*Watanabe, N. 1919. On blastomycetic meningitis, *Mitt. Med. Fak. Univ. Kyushu, Fukuoka* 5: 1-16.

Watts, James W. 1932. Torula infection, a review and report of two cases, *Amer. Jour. Path.* 8: 167-191, *Pls. 29-33.*

Weidman, Fred D. 1922. Resemblance of yeasts in cutaneous scrapings to Hyphomycetes, *Arch. Derm. Syphilol.* 5: 325-328.

—. 1930. The effects of gentian violet and crystal violet on certain pathogenic yeasts, *Urol. Cutaneous Rev.* 34: 215-225.

—. 1933. Cutaneous torulosis, the identification of yeast cells in general in histologic section, *Southern Med. Jour.* 26: 851-863.

Weis, Joseph D. 1902. Four pathogenic Torulae, *Jour. Med. Res.* 7: 280-311, *Pls. 21-24.* [n. s. 2.]

Weiss, Charles. 1928. A review of the recent literature on tropical sprue, *Arch. Path. Lab. Med.* 6: 885-900.

Weiss, Charles & Francis Landrón. 1928-1929. Immunological investigations of tropical sprue in Porto Rico. I. Monilicidal activity of the blood in sprue, *Amer. Jour. Trop. Med.* 9: 83-86, 1929. II. Skin reactions with toxins of Monilia, *Ibid.* 9: 87-91, 1929. III. Attempts at transmission of sprue to monkeys and human volunteers, *Ibid.* 9: 92-95, 1929. IV. Biology of Monilia psilosis in relation to sprue, *Jour. Infect. Dis.* 43: 557-564, 1928.

Weller, C. V. & A. D. Riker. 1930. Rhinosporidium Seeberi; pathological histology and report of a third case from the United States, *Amer. Jour. Path.* 6: 721-732.

Wells, H. Gideon. 1898. Preliminary report of a case of blastomycetic dermatitis, *New York Jour. Med.* 67: 427-430.

Wernicke, Robert. 1892. Ueber einen Protozoenbefund bei Mycosis fungoides? *Centralbl. Bakt.* 12: 859-861, *Pl. 6.*

Wettstein, Richard von. 1885. Untersuchungen über einen neuen pflanzlichen parasiten des menschlichen Körpers, *Sitzungsber. K. Akad. Wiss. Wien.* I, 91: 33-58.

White, Charles J. 1927. Fungus diseases of the skin, clinical aspects and treatment, *Arch. Derm. Syphilol.* 15: 387-404.

White, Charles J. & J. H. Swartz. 1928. Cryptococcosis epidermica, *Arch. Derm. Syphilol.* 18: 692-705, *5 figs.*

White, Cleveland. 1927. Studies in mycotic dermatitis. I. Superficial yeast infections of the glabrous skin, *New York State Jour. Med.* 27: 1116-1120 [1·9]. [Same title, *Arch. Derm. Syphilol.* 18: 429-438, 1928.]

Whitfield, Arthur. 1908. Microscopical specimen and pure culture of a yeast derived from a case of intertriginous dermatitis of the cruroscrotal region, *Proc. R. Soc. Med.* 1: *Derm. Sect.*: 190. [Reprinted, *Brit. Jour. Derm. Syphilis* 20: 274, 1908.]

—. 1909. A microscopical specimen of a mould fungus obtained in a scraping from a case of chronic dermatitis of the glans penis, *Proc. R. Soc. Med.* 2: *Derm. Sect.*: 90.

Whitman, Ross C. 1913. A contribution to the botany of the organism of blastomycosis, *Jour. Infect. Dis.* 13: 85-94.

Wieben, Magdalene. 1927. Die Infektion, die Myzel überwinterung und die Kopulation bei Exoascaceen, *Forsch. Gebiete Pflanzenkrankh. Immunität im Pflanzenreich* 3: 139-176.

Wilhemi, Armand. 1899. Beiträge zur Kenntnis des Saccharomyces guttulatus (Buscalioni), *Centralbl. Bakt.* II, 4: 305-309, 353-361, 412-417, 713.

Wilhelmj, C. M. 1925. Primary meningeal form of systemic blastomycosis, *Amer. Jour. Med. Sci.* 169: 712-721.

Will, H. 1903-1916. Beiträge zur Kenntniss der Sprosspilze ohne Sporenbildung welche in Bräuereibetreibung und in deren Umgebung vorkommen. I, *Centralbl. Bakt.* II, 10: 689-700, 1903; II, *Ibid.* 17: 1-3, 1907. III, *Ibid.* 17: 3-7, 75-90, 137-146, 331-334, 428-445, 604-614, 693-712, *3 pls.*, 1907. IV, (nach Untersuchungen von J. Dachs), *Ibid.* 21: 386-392, 459-469, 1908. V, (nach Untersuchungen von J. Schenckenbach), *Ibid.* 34: 1-35, 1912. VI, *Ibid.* 46: 226-280, *1 pl.*, 1916.

—. 1910. Beiträge zur Kenntnis der Gattung Mycoderma nach Untersuchungen von Hans Leberle, *Centralbl. Bakt.* II, 28: 1-37, *15 figs.*

—. 1915. Vergleichende morphologische und physiologische Untersuchungen an vier Kulturen der Gattung Pseudosaccharomyces Klöcker (Saccharomyces apiculatus Reess), *Centralbl. Bakt.* II, 44: 225-290, *1 pl.*, *6 figs.*

Williams, J. R. 1922. Systemic blastomycosis, *Med. Jour. Australia* 2: 186, 187, *4 figs.*

Winkel, Ludwig. 1920. Ueber die Lymphangitis epizootica des Pferdes mit besonderer Berücksichtigung der Therapie, *Monatsh. Prakt. Tierheilk.* 30: 385-433, *1 fig.*

*Winkler, Jos. 1898. Lungenentzündung bei Rindern, *Woch. Thierheilk.* 177.

Wlaeff. 1900. Levures pures dans un sarcome de l'utérus chez une femme, *C. R. Soc. Biol.* 52: 759, 760.

Wohl, Michael G. 1923. Fungous diseases of man in the state of Nebraska. Sporotrichosis blastomycosis, actinomycosis, *Trans. Sect. Path. Physiol. Am. Med. Ass.* 74: 26-45, *10 figs.* [Condensed, *Jour. Amer. Med. Ass.* 81: 647-643, *10 figs.*]

Wolbach, Simeon Burt. 1904. The life cycle of the organism of dermatitis coccidioides, *Jour. Med. Res.* 13: 53-60, *Pls. 1-3.*

—. 1915. Recovery from coccidioidal granuloma, *Boston Med. Surg. Jour.* 172: 94-96.

Wolfram, St. & Franz Zach. 1933. Über einige durch niedere Pilze verursachte Nagerler krankungen beim Menschen, *Arch. Derm. Syphilis* 169: 95-104, *5 figs.*

Wood, Edward Jenner. 1915. The occurrence of sprue in the United States, *Amer. Jour. Med. Sci.* 150: 692-699.

—. 1919. Recognition of tropical sprue in the United States, *Jour. Amer. Med. Ass.* 73: 165-168.

—. 1925. Pernicious anemia in its relationship to sprue, *Amer. Jour. Med. Sci.* 169: 28-39.

Wortis, S. Bernard & Henry B. Wightman. 1928. Case report of Torula meningitis, *Bull. N. Y. Acad. Med.* 4: 531.

Wright, Jonathan. 1907. A nasal sporozoön (Rhinosporidium Kinealyi), *N. Y. Med. Jour.* 86: 1149-1152.

Wright, R. E. 1922. Rhinosporidium Kinealyi of the conjunctiva, *Indian Med. Gaz.* 57: 6, 7, 82, 83, *2 figs.*

—. 1922. Rhinosporidium Kinealyi of the conjunctiva cured by tartrated antimony (tartar emetic) and notes on a case in which the lacrymal sac was affected by this sporozoön, *Indian Med. Gaz.* 57: 81, 82, *2 figs.*

Wright, R. E. & T. S. Tirumurti [Trimurthi]. 1922. Rhinosporidium Kinealyi, *Indian Med. Gaz.* 57: 270, 271.

Yamamoto, K. 1929. Über Cystitis blastomycetica, *Jap. Jour. Derm. Urol.* 29: 609, 610 [wholly in Japanese].

*Yukawa, Matao, Wataru Yositome & Sueo Misio. 1931. Serological identification of yeasts, third report, *Bulteno Sci. Fakult. Kjusû Imp. Univ. Fuknoka, Japan* 4: 267-281.

Zalesky, Nicolas. 1864. Ein Fall von Soor im Magen, *Arch. Path. Anat. Physiol.* [Virchow] 31: 426-430.

Zeisler, Erwin P. 1927. Monilia infection of the tongue, *Arch. Derm. Syphilol.* 15: 171-185, *9 figs.*

—. 1932. Chronic coccidioidal dermatitis, report of an unusual case, *Arch. Derm. Syphilol.* 25: 52-71, *16 figs.*

Zenker. 1861. Encephalitis mit Pilzentwicklung im Gehirn., *Jahresber. Gesellsch. Natur. u. Heilk. Dresden* 1861-1862: 51, 52.

Zenoni, Costanzo. 1912. Fisiopatologia dell'infezione oidica nell'uomo e negli animali con speciale riguardo ad un caso di oidiomicosi epatica con ittero grave da Oidium roseum non liquefaciens, *Sperim.* 66: 33-66.

Zepponi, G. 1931. Some observations on certain species of Monilia, *Jour. Trop. Med. Hyg.* 34: 122-124, *1 pl.*

Zimmer, M., J. Weil, Antoine Sartory, R. Sartory & Jacques Meyer. 1932. Ein Fall von Blastomykose durch Spontaninfektion mit einem echten Saccharomyces, *Arch. Derm. Syphilis* 167: 211-221, *7 figs.*

Zingale, Michele. 1923. Sulle epidermomicosi delle mani e dei piedi (simulanti l'eczema, la disidrosi, l'intertrigine) con speciale riferimento a due esse descritte da Kaufmann-Wolff, *Giorn. Ital. Mal. Ven. Pelle* 64: 929-946.

Zinsser, Hans. 1907. Experimental blastomycotic lesions, *Proc. New York Path. Soc.* n.s. 7: 121-129.

Zoon, J. J. 1930. Blastomycosis cutis durch Monilia Fioccoi mit positiver Blutkultur, *Derm. Zeitschr.* 58: 356-367.

—. 1931. Tierversuche mit Monilia Fioccoi. Nachtrag zur Arbeit: ''Blastomycosis cutis u.s.w.,'' *Derm. Zeitschr.* 61: 232-238.

Zschokke, E. 1913. Ein Rhinosporidium beim Pferd, *Schweizer Arch. Tierheilk.* 55: 641-650.

Zusch, O. 1901. Ein Fall von Noma mit ausgedehnter Soorbildung in hohem Alter, *München. Med. Woch.* 48: 785-787.

CHAPTER XV

PLECTASCALES

This group resembles the Spermophthoraceae and differs from the other families of the Endomycetales in that the zygote first develops ascogenous hyphae which then proceed to the formation of asci and ascospores. The Plectascales are distinguished from the higher groups of Ascomycetes by having the asci born in tangled wefts of partially differentiated hyphae. Where a more compact fructification (perithecium) is present, it lacks an ostiole and its asci are irregularly scattered throughout the inner tissue. The outer wall of the perithecium is usually composed of pseudoparenchyma which degenerates or decays, liberating the mature ascospores. Of the five or six families into which this group is generally divided, we need discuss only three: the Gymnoascaceae, the Aspergillaceae, and the Onygenaceae. The more elaborate fructifications of the other families need further study before their relationships will be altogether clear. Dodge (1929) followed the traditional arrangement, more or less confirmed by Emmons & B. O. Dodge (1931) and questioned by Nannfeldt (1932).

GYMNOASCACEAE

The simplest member of this group whose morphology and cytology have been studied is *Amauroascus verrucosus* (Dangeard 1907) usually found on dung as a white, arachnoid covering. Occasionally it thickens to small white knots, the fundaments of fructifications. The multinucleate copulation branches may develop from any two hyphae (Fig. 71, *1*, *2*). The antheridium (male) is vertical and somewhat the larger; the slenderer ascogonium (female) coils in a helix about the antheridium. Neither cytoplasmic fusion nor nuclear migration has yet been reported. The ascogonium continues to grow (Fig. 71, *3* and *4*), putting forth many branches which coil helically (Fig. 71, *5*) and eventually divide into binucleate cells that swell to 8-spored asci (Fig. 71, *6, 7*). Meanwhile a more compact, sterile tissue surrounds the knot of ascogenous hyphae. The asci are then embedded in a loose, brownish hyphal cushion which shows no differentiation of a wall.

When *Arachniotus candidus* is cultivated on Pollacci agar, it fails to form perithecia and resembles the Trichophytoneae in many microscopic details (Pollacci 1925).

In *Gymnoascus*, the hyphal sheath shows a more marked peridial character. This genus is saprophytic on earth, dung, cadavers, offal, etc., where it forms a fluffy, occasionally bright-colored covering. The slender hyphae are divided into short, multinucleate cells. In some species, such as *G. setosus* (Fig. 72), they laterally abjoint hyaline conidia which may develop by sprouting; while in other species, such as *G. uncinatus,* they break up into arthrospores.

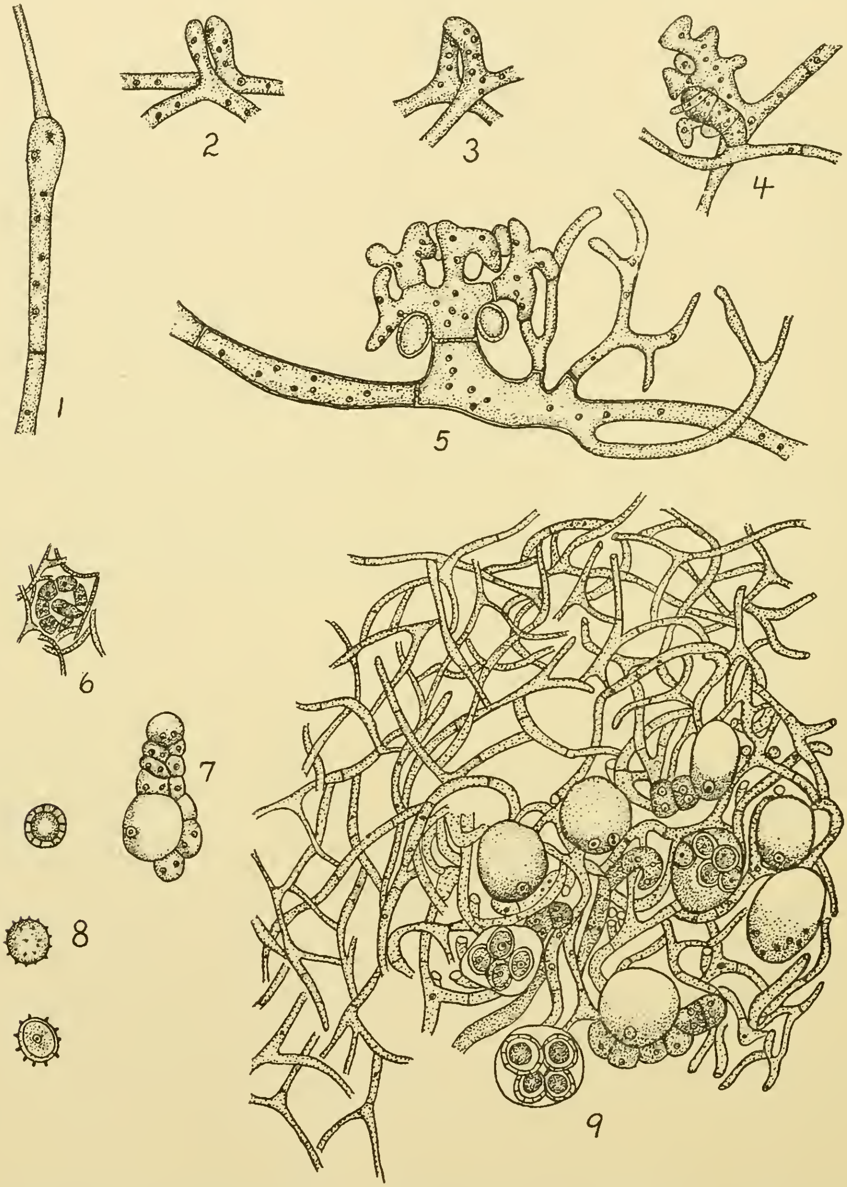

Fig. 71.—*Amauroascus verrucosus.* *1,* mycelium; *2, 3,* young ascogonium and antheridium; *4, 5,* ascogonium developing parthenogenetically, while nuclei degenerate in antheridium; *5,* beginning of septation and formation of sterile hyphae; *6, 7,* ascogenous hyphae; *8,* ascospores; *9,* perithecium with ascogenous hyphae and young asci (×900). (After Dangeard 1907.)

In *G. Reesii,* the only species carefully investigated, no imperfect forms have been described. Each of two neighboring cells of a hypha abjoints a copulation branch, generally simultaneously, although occasionally the antheridium appears somewhat earlier. The ascogonium coils helically, and the terminal cells of the antheridium and ascogonium fuse. The male nucleus migrates into the ascogonium, which divides by septa into the binucleate (?) cells which develop ascogenous hyphae. From the latter, 8-spored asci develop

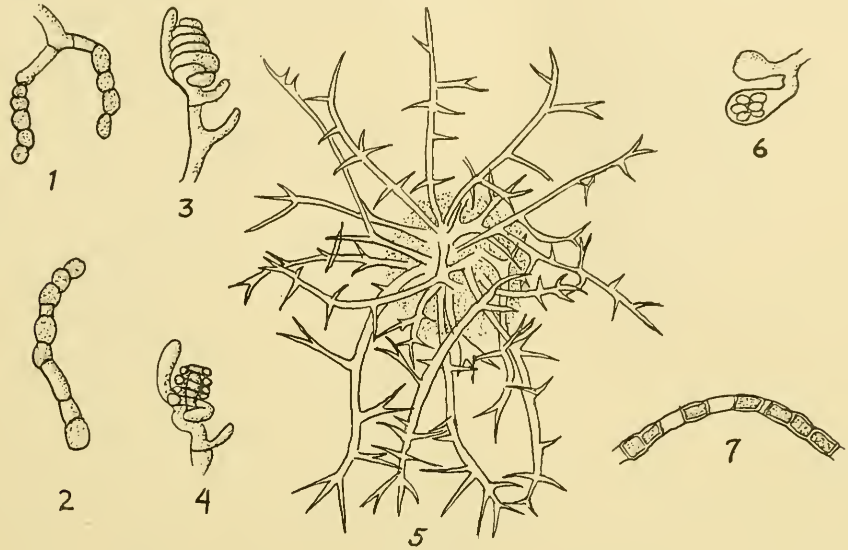

Fig. 72.—*Gymnoascus setosus* (*Eidamella spinosa*). *1, 2,* chains of arthrospores; *3, 4,* stages in copulation; *5,* peridium, showing ornamentation of spines; *6,* ascus with ascospores; *7,* chlamydospores. (After Matruchot & Dassonville 1901.)

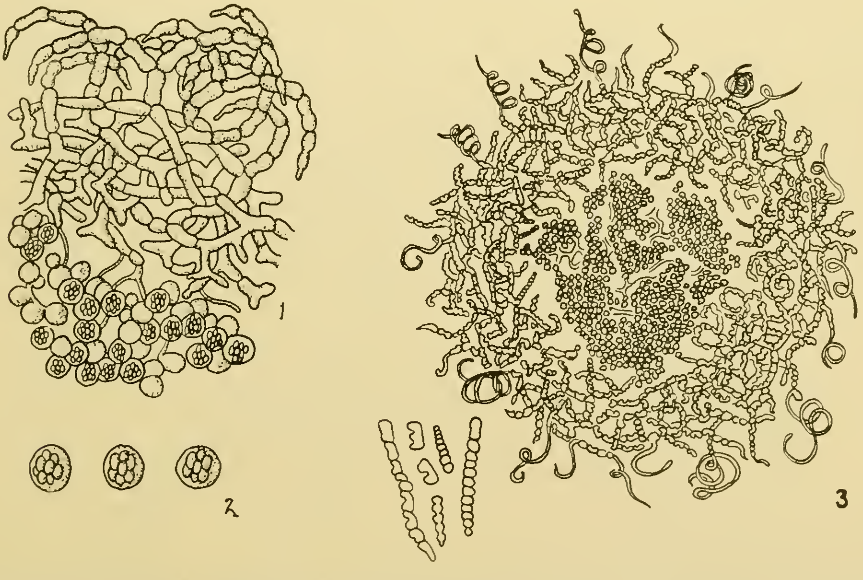

Fig. 73.—*1* and *2, Gymnoascus gypseus. 1,* section showing perithecial ornamentation above, and asci below; *2,* mature asci. (After Nannizzi 1926.) *3, Ctenomyces serratus;* section of conidial stage (×200). (After Eidam 1880.)

either terminally or laterally. Meanwhile the sexual organs become surrounded with a loose mycelial weft, or stroma, whose peripheral hyphae form peculiar lateral thick-walled, brown spines (Eidam 1883, Dale 1903).

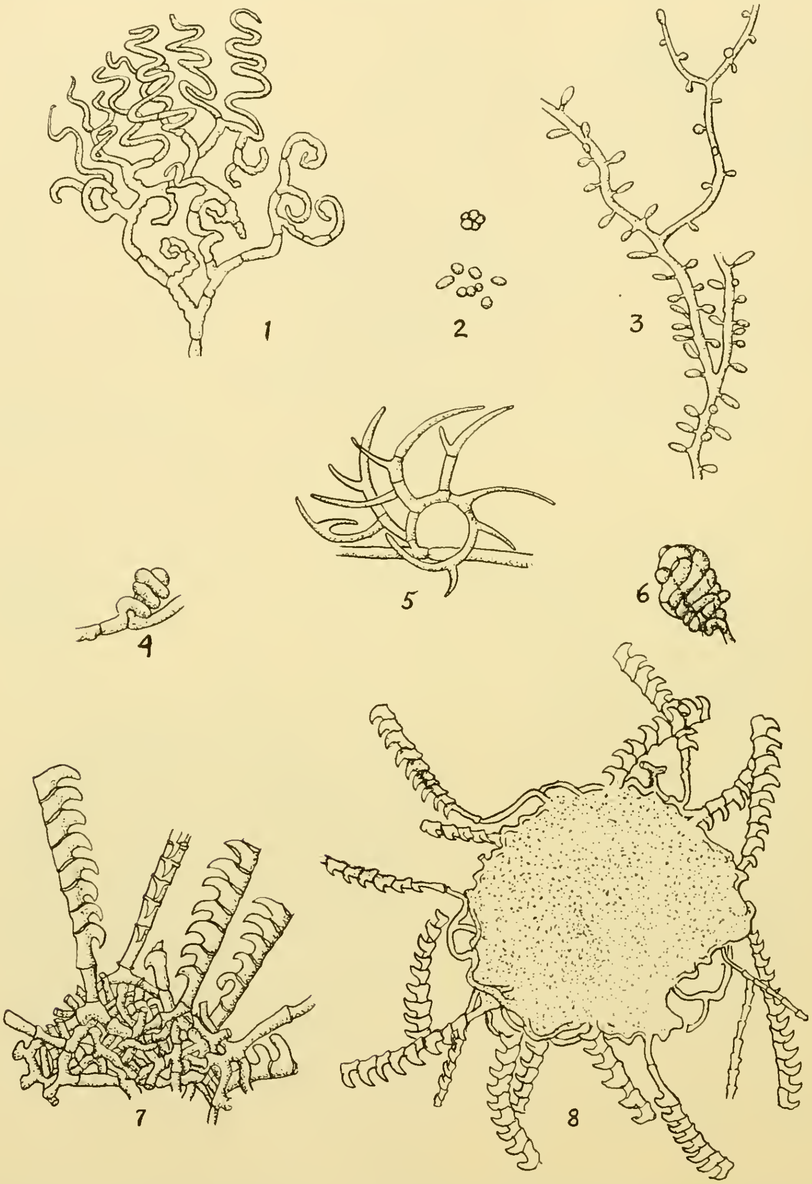

Fig. 74.—*Ctenomyces serratus.* *1*, spiral hyphae; *2*, ascospores; *3*, mycelium with aleurospores; *4*, *6*, early stages of copulation; *5*, mycelium beginning to form cover for asci; *7*, resting mycelium with pectinate hyphae; *8*, ascocarp with pectinate hyphae. (After Eidam 1880.)

A more compactly built rind is found in *Ctenomyces* whose only well-known species, *C. serratus* (Fig. 73, *3*), occurs on decaying hen feathers. In its juvenile stage it forms hyaline hyphae which abjoint laterally numerous ovoid, hyaline aleurospores (Fig. 74, *3*). The hyphal cells are 1-4 nucleate, while the conidia are generally uninucleate. The conidiophores occasionally form a structure resembling a pycnium whose central cavity may be filled with the slimy mass of conidia.

The young copulation branches (Fig. 74, *4*, *6*) are 1-3 nucleate, the antheridium is a clavate, vertical structure which finally contains 10-12 nuclei. The ascogonium, which coils around the antheridium six or seven times, finally contains about 20 nuclei. Cytoplasmic fusion and nuclear migration have not yet been reported. The ascogonium divides directly into binucleate, almost isodiametric cells; whence arise ascogenous hyphae which again coil helically around the original helix. From this confused mass, the 8-spored asci develop. Meanwhile the whole knot is closely surrounded by sterile hyphae which, with a considerable thickening of their walls, become moniliform and develop short, peculiar processes on one side (Fig. 74, *7*). Besides these perithecia, light brown sclerotia are formed on the feathers. There are also unusual pectinate, falcate or setiform hyphae, all of whose unguiform processes are turned in the same direction. Possibly these serve to disseminate the sclerotia by clinging to animals. Some of these structures appear very similar to those found in the imperfect genera *Trichophyton, Microsporum,* etc.

The most compact rind apparently is found in *Ateleothylax,* a very imperfectly known genus, originally described from tinea capitis in Soudan. Nothing is known of its cytology and very little of its morphology. A second species probably belonging here has been described from tinea cruris in India. It seems quite possible that the black perithecia described in these species may belong to a contaminant. The cultural characters and imperfect stages would place them in *Trichophyton* and *Epidermophyton* respectively.

The systematic position of the ascogenous stage of *Microsporum japonicum,* producing tinea capitis in the yellow race, is very doubtful. It may represent a very degenerate stage with a complete loss of sexuality (Kambayashi 1932, see p. 547).

Key to Genera

Peridium of very thin-walled undifferentiated hyphae.	
Spore walls hyaline, yellow or red.	*Arachniotus.*
Spore walls brown or brownish violet.	*Amauroascus.*
Peridium of thick-walled, much branched hyphae forming a lattice.	
Tips of branches ending in spines.	*Gymnoascus.*
Tips of branches ending in spirals or helices.	*Myxotrichum.*
Tips of branches with many short side branches giving appearance of combs or saw-teeth.	*Ctenomyces.*
Peridium of thick-walled, greenish black hyphae, closely interwoven, suggesting perithecia of Aspergillaceae.	*Ateleothylax.*

Ctenomyces serratus Eidam, Beitr. Biol. Pfl. [Cohn] **3**: 377-433. *Pls. 19-23,* 1883; Matruchot & Dassonville, Bull. Soc. Myc. France **15**: 305-310, 1899.

Pathogenic for animals experimentally and closely resembling *Trichophyton* and other genera, when grown on the same media as the latter.

Stromata ovoid or subspheric, 0.5-1.5 mm., often confluent; mycelium hyaline, with walls with teeth close (Fig. 74, *7*) or distant; chlamydospores pluricellular, fusiform to pyriform; conidia ovoid, hyaline, inclosed in nests formed in the stroma, 5-6 × 2-3μ; asci ellipsoid, 8-spored, 5 × 4-5μ; spores agglomerated, tawny, ellipsoid.

Gymnoascus setosus Eidam, Bot. Centralbl. **3**: 106, 107, 1882.

Eidamella spinosa Matruchot & Dassonville, Bull. Soc. Myc. France **17**: 123-132, 1901; cultural characters in Bull. Soc. Cent. Méd. Vét. **56**: 50-71, 1902.

Isolated from skin lesions of a dog. Matruchot & Dassonville were unable to reproduce lesion exactly, although some epilation occurred in vicinity of inoculation.

Mycelium hyaline, much branched, 1.5μ in diameter, which is constant in submersed hyphae on liquid media, variable in air, 2-4 times less in places. Usual sexual reproduction of Gymnoascaceae. Perithecial hyphae much branched, lateral branches characteristically incurved; asci in clusters on the internal branches of perithecial mycelium, ovoid, 6-7 × 3-4μ, 8-spored, spores citriform, 3 × 1.5μ, hyaline; chlamydospores intercalary. On usual media the colony is white, velvety, secreting a gooseberry-red pigment in the substrate. The perithecia are black.

Gymnoascus gypseus Nannizzi, Atti R. Accad. Fisiocrit. Siena X, **2**: 93-95, 1927.

Achorion gypseum Bodin, Ann. Derm. Syphiligr. IV, **8**: 585-602, 1907.

Sabouraudites gypseus Ota & Langeron, Ann. Parasitol **1**: 326, 1924.

Producing favus in man, dog, cat, and fowl.

Wall of peridium loose, hyphae 4-5μ, hyaline, smooth without, up to 6-8μ, arcuate, simple, or dichotomous, or rarely with unilateral branches, finely echinulate; asci borne in racemes, 7-8μ in diameter, with 8 ascospores, smooth, hyaline, 4-5 × 3μ, asci diffluent at maturity (Fig. 73, *1*).

Colonies on Pollacci's agar (glucose) at first punctiform, cottony, floccose then effused, applanate, disciform, with lanceolate rays, white, later yellow or yellowish ochraceous, with pulverulent center, pleomorphic in age, villose, often slightly concentrically zoned. Sterile hyphae repent, straight, smooth, hyaline, here and there with clavate cells, hyphal tips curved or subcircinate, cells short, wall darker and slightly echinulate with granular content, irregular, often constricted in the middle, fertile hyphae erect or subdecumbent, simple, rarely short branched; aleurospores pyriform 3-5 × 2.5-3.5μ, easily deciduous, hyaline; closterospores 6-7 septate, not constricted, 40-60 × 12-15μ, finally granulose, echinulate, solitary or racemose or subverticillate, hyaline. Pleomorphic hyphae 2-2.5μ, in diameter, rarely producing a few aleurospores.

In hair, hyphae elongate, straight or tortuous, here and there breaking up into isodiametric or rodlike arthrospores of variable size. Since the researches of Nannizzi (1927) have not been confirmed by others (except by Biltris 1929), the work on the imperfect stage of this species will be included in the discussion of *Achorion* (see p. 553).

Ateleothylax Currii (Chalmers & Marshall) Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 333, 1923.

Trichophyton (*Endothrix*) *Currii* Chalmers & Marshall, Jour. Trop. Med. Hyg. **17**: 257-265, 289-291, 1914.

Matruchotiella Currii Grigorakis, C. R. Acad. Sci. Paris **179**: 1424, 1924.

Causing tinea capitis tropicalis in Soudanese boys between 10 and 16 years of age. Not inoculable into cat, dog, white mouse, or monkey.

Filaments in the hair 4-5μ in diameter. Terminal and intercalary chlamydospores abundant in older cultures, closterospores rare but present; perithecial stroma black, 500μ in diameter; wall composed of interlocked hyphae with thickened, greenish black walls, spores ellipsoid, slightly pointed at each end, uniguttulate.

Isolated in acid malt extract; subcultured into a solution of 4% glucose and 1% peptone or broth with –10 reaction. Milk not coagulated or acidified; a white pellicle formed on blue litmus milk; sugars not fermented. On Sabouraud maltose and glucose gelatins, an acute knob forms, surrounded by a white disc. On Sabouraud maltose agar at 37° C., growth forms a central knob, an elevated zone, and a slight marginal fringe. On the seventh day, there are two concentric zones, with furrow between inner zone and knob and four slight radial folds. On Sabouraud glucose agar in 5 days, a knob with white plateau and fringe; at 32° C. on carrot, growth visible on first day. On fourth day a small central white elevation, surrounded by a dark zone, depressed into the substance of the carrot, with a narrow white margin. At 32° C. on potato, growth grayish white at first becoming grayish black. On Buchanan's medium and Loeffler's blood serum, growth scant, with a white central elevation and white plateau.

Ateleothylax Viannai (Froilano de Mello) Dodge, n. comb.

Trichophyton Viannai Froilano de Mello, Indian Jour. Med. Res. **5**: 222-233, *7 figs., Pl. 34,* 1917.

Atrichophyton Viannai Castellani & Chalmers. Man. Trop. Med. ed. 3. 1009, 1919.

Sabouraudites Viannai Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Clinically similar to herpes circinatus on thighs, pubis, and anterior part of abdomen; hairs probably not infected. Cured by application of tincture of iodine.

Mycelium with small spores, 3-4μ. either lateral or terminal chlamydospores, spiral hyphae either lateral or terminal, lower portion enlarged like a bottle, upper portion spiral, of 5-20 turns, sometimes terminating in a cluster of spores; also pseudospirals or aborted spirals; large spherical asci (?) containing 1-4 black spores (?) and nodular organs very similar to *Aspergillus;* perithecia also present.

On Sabouraud maltose, colony 0.5 cm., dry, powdery, whitish or dirty yellow at first, becoming pale rose, with central point darker; not umbilicate; reverse yellowish brown in center, dirty yellowish at margin; not segmented, pleomorphism slow. On Sabouraud glucose, colony rose color tinged with violet.

Clinically the lesions suggest relationship with some of the pink species of the *Epidermophyton rubrum* group, while the presence of spiral hyphae suggests relationship with *Ectotrichophyton.*

CHAPTER XVI

TRICHOPHYTONEAE

This group of Fungi Imperfecti appears to be parasitic almost exclusively in the horny layer, or other keratinized structures (as hair and nails), of the integument of mammals. The Trichophytoneae, or dermatophytes, are probably imperfect stages of Gymnoascaceae, although definite proof has been found only in the case of *Gymnoascus gypseus,* and even here, others (Tate 1929) have not been able to confirm the results of Nannizzi (1926, 1927) and Biltris (1929). Much data have been accumulated since the work of Matruchot & Dassonville (1899, 1900, 1901) which points toward this conclusion, and it is probable that work on suitable media and environmental conditions will furnish the necessary proof. The figures of asci published by Wilenczyk (1926, 1927, 1928) are unconvincing, and careful work by Bruhns (1930) and others have wholly failed to confirm his statements. The work of Biltris (1929) is vague and needs further confirmation, although it is suggestive. The statement that the dermatophytes are related to the Ascocorticiaceae seems altogether improbable. The only structure in common is the ascus, and its mode of development is so different in the two groups that there seems to be little probability of close relationship.

Up to the present, attention has been centered primarily on the clinical, pathologic and, to a lesser extent, morphologic aspects of the dermatophytes with emphasis on the gross morphology of the giant colony and comparatively little on the physiology.

Most of the fundamental work on this group we owe to Sabouraud and his students. Since his interest has been strongly clinical as well as mycologic, he has evolved a classification based in part on the relation of host and parasite. The older generation of mycologists considered this practice to be of little value, although they were guilty of exactly the same practice in their classifications of plant pathogens and saprophytes, and often carried their own schemes to absurd lengths; e.g., von Hoehnel and other workers in the Ascomycetes, who usually did not even take the trouble to cultivate their organisms and practically never tried inoculations on various hosts. On the other hand, Guéguen (1910) and, to a certain extent, Bruhns and Alexander (1928) would base classification primarily on the lesions.

Recently, we have had several attempts to introduce new classifications, including the revision of Sabouraud by Castellani & Chalmers (1919) and by Nannizzi (1926), a purely morphologic one by Vuillemin (1925)—both the latter in violation of the fundamental principles of nomenclature—then an attempt to apply the rules of nomenclature to Grigorakis' classification by Guiart & Grigorakis (1927) a conflation of Ota & Langeron and Grigorakis by Ciferri

(1928) and a revision of Ota & Langeron by Langeron & Milochevitch (1930), reviving the use of media containing carbohydrates of high molecular weight (Noyes 1891). None of these classifications is altogether satisfactory. That of Sabouraud is the most useful for the dermatologist but suffers in the details of descriptions by his use of impure samples of glucose and maltose and of peptone of unknown composition for his culture media, although more or less satisfactory substitutes have been proposed. That of Grigorakis, aside from its completely untenable nomenclature, is based in part on a premise [suggested by Sabouraud (1910) for a few species] that some of the species of Sabouraud are degeneration stages in the life cycle of other species. He furnishes little experimental evidence in support of this hypothesis, although some suggestive data have been reported by subsequent authors. (See p. 457.)

The systems of Langeron and his coworkers are untenable, partly on account of the nomenclature used and partly because of the almost total disregard of physiologic and morphogenetic characters. In the present state of our knowledge, it seems better to continue the traditional classification of Sabouraud based upon forty years of continuous use by many workers, modifying it as may be needful for individual species, and bearing in mind that the clinical characters should not be used to the exclusion of the morphologic, morphogenetic, and physiologic. Much nomenclatorial instability results from the arbitrary consideration of certain characters to the exclusion of a consideration of the organism as a whole. The polemics of the last few years in the three-cornered controversy of Sabouraud, Langeron and Grigorakis might have been avoided had some of the writers considered judiciously all the knowledge available regarding each organism and not emphasized isolated facts which fitted or failed to fit certain more or less theoretical considerations.

Since clinical data are so frequently used in the study of this group, a brief account of the various types of lesions will be given for the benefit of the botanist who may have no background for the proper appreciation of their importance. The account is abridged largely from Sabouraud's classic work (1910) to which the reader is referred for an exhaustive historical account and for further details. In this connection, the reader who wishes to bring his knowledge up to date will find useful the series of articles by Sabouraud (1928, 1929, 1932) which contain many additions and corrections to his earlier work.

Most of the lesions are approximately circular in outline since growth from the inoculum is equally rapid in all directions, a phenomenon essentially the same as that which produces fairy rings in mushrooms. Because of this character, the ancient Greeks named the disease *herpes*—a name which has persisted to our day. In order to distinguish herpes of fungus origin from *herpes febrilis* and *herpes zoster*, it is usually referred to as *herpes circinatus*, *herpes tonsurans*, or *herpes desquamans*. Similarly, the Romans linked these diseases with those caused by lice and applied the name *tinea*, which originally meant any tiny insect larva, such as a bookworm or clothes moth. A combination of the Greek and Roman ideas has given us our English *ringworm* as a general term for these fungus infections.

The fungi of this group often attack the young of the species, before sexual maturity, in man (Sabouraud 1910 et al.), the horse (Brocq-Rousseu 1926) and neat cattle (Jeanselme, Bloch & Hutinel 1923). After puberty, many species disappear completely while others grow much more slowly, probably because of changes in concentration of hydrogen ions; e.g., Vamos (1932) found the pH of the skin before puberty (hairy areas) to be 6.2-6.5 while after puberty it had increased to 4.5-5.6. Medication with gonadal extracts has been used with the aim of controlling the disease by hastening the advent of puberty in those cases in which puberty is expected shortly (Neuber 1930). Occasionally species (usually of the subgenus *Bodinia* of *Favotrichophyton*), which are generally confined to the prepubertal stage, are found on senile individuals or very rarely on normal (?) adults. Although the case histories do not mention the matter, it would seem quite probable that gonadal deficiency existed in these adults. Other organisms, such as those of sycosis and to a less extent, species of the genus *Epidermophyton,* seem to be largely confined to the male after puberty. In the case of eczema marginatum and tinea interdigitalis, no age or sex is wholly free, although the greater portion of the cases are found in young unmarried males, shortly after puberty, particularly among students, athletes, and soldiers.

The lesions are essentially benign, because they are limited to the superficial horny layers of the tegument, and applications of relatively simple antiseptics suffice for their destruction. If the fungus reaches the hair, the latter continues to grow normally. The parasite invades it as fast as it forms, so that if it is not treated, the fungus may continue its growth for many years. Although many species have been described from different parts of the world, there are but few important ones in any one locality, usually not more than two for any one clinical type of lesion.

Since members of this group are practically confined to the horny layer of the epidermis or to keratinized structures, such as hair and nails, we may discuss the lesions produced in the different structures in this order. While theoretically an organism might invade all of these structures, such cases are very rare, for the greater part of the organisms are typically confined to one of these structures and on passing to another produce only mild, evanescent lesions.

In the horny layer of the epidermis the lesion varies both with the organism and the position of the epidermis. Practically all members of the group start their growth in this layer, those infecting hair follicles, hair and nails soon penetrating into those structures, scarcely affecting the epidermis save to produce a scaling. Of those which remain in the horny layer of the epidermis, we may consider separately those of the dry portions, those of moist regions in folds (e.g., eczema marginatum of the inguinocrural fold and the interdigital spaces) and those on the very thick horny layer of the palmar and plantar surfaces.

On the drier portions of the epidermis, there are two types, one dry and scaling, the other vesiculose, rarely pustulose. Each produces a circular lesion which may become a ring after the central area has healed spontaneously. The fungus is most abundant and active at the margin of the advancing lesion, hence scales or vesicles from this area are most suitable for study. Infection is frequent in the uncovered portions of the body as might be expected, since many of the sources of infections are domestic animals. One case has been reported on the anus. The infection may be either a single large lesion, or rather generalized and exanthematous by subsequent inoculation of other portions of the epidermis from the original lesion or as a result of allergic phenomena. (See p. 474.)

In the first or scaling type, the lesion begins as a small red slightly elevated spot which spreads. The central portion is covered with small scales, occasionally larger and almost psoriasiform, while the margin remains red. The amount of redness varies from not much more than that of pityriasis versicolor, to quite red and slightly swollen lesions. Occasionally a few evanescent vesicles are formed.

In tinea imbricata from India, Ceylon, Southern China from Szechwan to Formosa, and from the Malay Archipelago, the lesion first appears as small vesicles, which dry. The epidermis peels back in triangular flakes with one free angle toward the center of the lesion and the opposite side attached to the sound skin. New rows of vesicles at the periphery continue to develop new triangular scales, often producing patterns of considerable intricacy, especially if the initial infections were approximately symmetrical. The palmar and plantar surfaces are not attacked; the scalp, the scrotum, and moist folds of the skin, very rarely. The hair is never infected. Jouveau-Dubreuil (1919) suggests that infection is caused by scratching or enters through an open sore rather than by simple contact. The disease is apparently of many years' duration, not healing spontaneously.

In the second or vesiculopustular type, vesicles arise either irregularly or in a ring just back of the margin which is hyperemic and edematous. The formation of a crust is followed by spontaneous healing from the center outward. Pigmentation of the skin increases at the center and varies with the normal amount of pigment in the skin. Occasionally pustules form, but this usually signifies infection of the hair follicle; therefore we shall study these along with lesions involving follicle and hair. Scratching, following the pruritus which often accompanies the lesions, may lead to lichenification or to secondary infections. Hyphae and chains of arthrospores are usually demonstrable in the scales. When this type becomes chronic (Podwyssotzkaja & Rosenthal 1933) it is often located on the knee or elbow, spreading upward and downward to the adjacent regions of the leg and arm. It may also start on the buttocks or the hands. Very frequently the nails become infected, probably from scratching, and in turn may help to spread it to other regions. In this chronic state it seems largely confined to females, most of whom have contracted this disease soon after puberty. *Favotrichophyton violaceum* seems to be the commonest organism isolated from this type, although *Ectotrichophyton mentagrophytes* and *Trichophyton tonsurans* have also been reported. The horny layer develops hyperkeratosis, the fungus is no longer found in it. Subcorneal microabscesses develop along with edema and leucocytes in the intercellular spaces. The wall of the hair follicle is greatly thickened and spores may still be seen, the lumen becomes smaller and the surrounding area infiltrated, reaching the derma, but no fungus spores are to be seen in the latter region. Frequently allergic phenomena develop, producing secondary lesions which closely resemble the original lesion though the fungus cannot be demonstrated in these lesions. This is often the case in the generalized exanthematous types.

In the moister regions of the epidermis, such as the principal folds (the axilla, the submammary, the inguinocrural folds, and the interdigital spaces), there are two main types: eczema marginatum of Hebra originally described from the inguinocrural fold and chiefly confined there (often known as dhobie itch, jock-strap itch, red-flap, etc.), and the dysidrosiform and intertriginous mycoses of hands and feet, usually starting in the interdigital spaces but often spreading thence to the palmar and plantar surfaces where the much thicker horny layer of the epidermis gives the lesion a different appearance.

Eczema marginatum was first differentiated clinically and its fungus nature shown by Devergie in the second edition of his *Maladies de la Peau*, p. 275, 1857 [quoted by Sabouraud 1910, p. 427]. However, Hebra in 1860 gave a much fuller account, which has remained practically unmodified since, except in a few minor details, such as its extension to scrotum and penis, and its occasional occurrence in the submammary fold and in the axilla. While not confined to any age or sex, it is most frequent in active, mostly unmarried, males shortly after puberty, often reaching epidemic proportions in schools, universities, or barracks (Dubreuilh & Foutrein 1895, Foutrein 1895, Sabouraud 1907, Symes 1909), and occasionally in families (Fox 1878). It is probably spread by towels, clothing, and benches in locker rooms which are often used promiscuously by young adolescents in dormitories and gymnasiums. Perrin (1896) mentions several cases of contagion following sexual contact. Apparently for infection to occur, the epidermis must be moist almost to the point of maceration, but Hallows (1922) reports two cases on the mons jovis of prepubertal boys. Most cases begin on the thigh where it is in contact with the scrotum (the left side in three-quarters of the cases). It spreads rapidly, involving the inner side of the thigh and the gluteal and pubic regions, sometimes as high on the hypogastric region as the umbilicus; rarely also the scrotum and the shaft of the penis, one case being reported in which infection spread to the glans.

The lesion begins as a round, red, elevated spot with intense pruritus. Soon the center becomes paler and pigmented brown; only the margin shows the characters of the active lesion. This normally consists of small vesicles, filled with a serous liquid. These open spontaneously, leaving a slight crust and scales. By this time the pruritus has usually caused extensive scratching followed by punctiform excoriations and black or brown crusts in which blood from scratching is mingled with the exuded liquid. Unless secondary infection sets in, healing begins in the middle, leaving brown normal skin which gradually fades. As it spreads, growth is more variable; the circular appearance is lost and it gradually becomes polycyclic and irregular in outline. New lesions may have started from autoinoculation by scratching, which spread and fuse with the original lesion. Rarely the red border is lacking, and the lesion remains red and furfuraceous for some time. It suggests pityriasis rosea but it is more inflammatory (Arzt & Fuhs, 1924). Another type, still rarer, shows a more inflammatory lesion elevated 2-3 mm. above the healthy skin with its surface full of small vesicopustules. The disease may become chronic without treatment, lasting a year or more, with recurrence after apparent healing unless properly treated. Karrenberg (1928) reports an erythrasmoid type.

In the interdigital folds (usually confined to the toes), perhaps because of the higher and more constant moisture content of the epidermis, the skin of the fold is dark grayish red, the horny layer thin, dry and shining, or moist and eroded, soon disappearing over part of the lesions. Deep in the fold are found white, macerated scales or larger swollen membranous sheets of epidermis. The margins are distinct and curved, the horny layer separating, allowing large flakes to be pulled off. Commonly, but not always, some vesicles may be found. Rarely does the lesion extend to the dorsal part of toe or foot, and it usually does not extend much beyond the area in which the toes are in contact with the plantar surface. Pruritus may be present and intense or it may be absent. The interdigital spaces of the hands are rarely infected, perhaps owing to lower moisture content. Various species of *Monilia* seem to be the common occupants of this site, producing lesions quite similar to those of the feet. Cleveland White (1928) reports a case of inguinal lymphadenitis accompanying interdigital lesions, in which he was able to isolate *Epidermophyton interdigitale* from the inguinal lymph nodes.

When the palmar and plantar surfaces are attacked, usually a dysidrosiform or a hyperkeratotic lesion results. The principal symptom of this lesion is translucent gray red to steel blue vesicles in the horny layer, suggesting grains of sago and varying in size from that of a pinhead to that of a lentil. Where the horny layer is thick, as on the soles of the feet, the vesicles are below the level of the surface, but where the horny layer is thinner, as on the hands and toes, the vesicles are raised slightly above the surface. Frequently, especially on the feet, the vesicles appear yellowish milky from pus formation. The vesicles or pustules seldom open spontaneously to produce a moist eczema.

After a while the contents of the vesicles dry, the covering cracks and peels off, leaving a rose colored area surrounded by a border of loosened horny layer. Near the first vesicles, new ones form, dry, and peel, leaving a gradually widening irregular area of pink, surrounded by the loose horny layer. On the hands the lesions are likely to be less confluent, resembling the clinical picture described by the older authors as dysidrosis (see clinical discussion of Strickler, Ozellers and Zaletel, 1932, Schmidt, 1933), or it may be very difficult to differentiate from some dermatitis of chemical origin without a knowledge of occupation and other facts of case history. The duration may be very long, the lesions tending to heal when the weather is cool and the feet less moist, and recurring in warm weather when the feet perspire freely. (See statistics of Sharp and Taylor 1928.) It is often puzzling to decide whether some of these recurrences may not be due rather to reinfection from socks which have not been sterilized in the process of laundering, bath slippers, or other articles of clothing. Woolen or silk socks, especially, may be sources of reinfection, as they are rarely, if ever, sterilized in the ordinary course of events.

Eczema marginatum seems predominantly to attack the adolescent and those of the succeeding decade, in America being spread especially in shower baths connected with gymnasiums, swimming pools, etc. An examination of 3,100 freshmen of one of our large universities showed 53.3% of the men and 15.3% of the women were infected when entering the university and a reexamination at the end of the year showed that 78.6% of the men and 17.3% of the women were infected; also that 9.3% of the men had become infected with tinea cruris (Legge, Bonar & Templeton 1929), the increase being largely due to unsanitary conditions about the gymnasium and perhaps fraternity houses. Levin & Silvers (1931) suggest that sweat is important in transmission. These figures are typical of most of our universities, where the athletic directors and university physicians are ignorant and apathetic. On the other hand, some of our high school physicians are very active in the matter and have shown a remarkable control of the disease following the introduction of comparatively simple prophylactic measures. By supplying troughs or depressions in the floor between the shower and locker rooms which are filled with a disinfecting solution, such as 10-15% sodium thiosulphate (Gould 1931) or 1% sodium hypochlorite (Osborne & Hitchcock 1931), the percentage of infection in the Albany Junior High School was reduced from 50% to practically no infection in a few months and in the Buffalo high schools, from a large percentage at the beginning of the school year to complete disappearance before the end of the year. Lomholt (1933) reports about 60% infection in a group of Danish students living in a single dormitory.

Much less frequently a scaly hyperkeratotic form occurs on the feet. This may be only a less active form of the dysidrotic type or may be caused by a species of *Trichophyton* rather than *Epidermophyton*, which is the usual organism attacking hands and feet. A diffused thickening of the horny layer on the inner border and ball of the great toe or even of the whole plantar surface may occur. The formation of vesicles is rare, but the thickened layer loosens and peels, giving the syndrome of dysidrosis lamellosa sicca. Fungi are rather difficult to isolate in these cases. Sabouraud reports *Trichophyton tonsurans* from similar lesions on his own hands (probably accidental infection) and *T. persicolor.* He also reports *Favotrichophyton violaceum* (*Trichophyton violaceum*) causing lesions of the dysidrotic type. Gonzales Urueña (1930) reported *Ectotrichophyton mentagrophytes* var. from a Mexican case, while Photinos (1928) reported *Favortrichophyton ochraceum.*

In the interior of Java and Borneo, perhaps also in Sumatra and New Guinea, a somewhat similar condition is caused by *Aleurisma albiciscans* (*Trichophyton albiciscans*). The systematic position of this fungus is uncertain, as we know nothing of its cytology (see p. 788).

In tinea unguium, when *Trichophyton* attacks the nails, it may be by direct infection or by infection from a neighboring lesion of the epidermis. It begins on the lateral border of the nail as an opaque, extensive yellowish white spot with irregular margins below the external layer. From this stage it may develop in two ways, depending on whether the external layer is involved or not. If this layer is not involved, it covers a thick, spongy layer 3-5 times its ordinary thickness, whose substance at the free edge is friable. The surface of the nail is often concave and petaloid, sometimes with longitudinal fissures, opaque, gray-white, or slightly yellowish. In other cases, the spongy mass is so friable that it is easily dissociated and removed, the upper layer covering an empty space over the upper half of the nail. In these cases the nail becomes convex in two directions, producing onychogryposis. Finally, the upper layer may be destroyed. In the second type, where the upper surface is early attacked, it is fissured, soon becomes soft, and wears away. It is then atrophic and reduced to half its normal length. The roughened surface soon accumulates dust and dirt. Usually this process proceeds without inflammation. Gradually other nails become infected until sometimes all are attacked. Microscopic examination shows little difference from that of nails attacked by favus (see p. 443). The disease may last 10 years or more; very rarely a nail recovers spontaneously. The organism has been cultivated in comparatively few cases, but Sabouraud reports both *T. Sabouraudi* (*T. acuminatum*) and *Favotrichophyton violaceum* (*T. violaceum*) as causal agents, Bresciani (1925) a case due to *Microsporum Audouini,* Chalmers & Marshall (1918) one due to *Epidermophyton floccosum* ? (*E. inguinale*), Heller (1923) lists *M. Audouini, T. Sabouraudi* (*T. acuminatum*), *F. violaceum, T. flavum* (*T. cerebriforme*) *T. plicatile, T. tonsurans* (*T. crateriforme*). Hodges (1921) adds *Epidermophyton rubrum* (*Trichophyton A, B*), and *E. interdigitale* (*Trichophyton C*).

Of the various lesions associated with the hair follicle and hair, the first to be differentiated clinically, and the most distinct, is that of favus. The favic scutulum (godet of French writers) is a yellow crust resembling a lupine seed which gave the disease some of its older names, such as *porrigo* *lupinosa, tinea lupinosa*, etc. It is lenticular in shape with a depression above. The hyphae and spores which compose it, form a ring about the follicular orifice in the thickness of the horny layer of the epidermis. This ring, scarcely visible at first, often attains the size of a pea or even greater. It occurs only about a follicular orifice and begins as a flat intraepidermic pustule, which contains white pus, due to the infiltration of leucocytes. At the base of the pustule is a yellow disc, the beginning of the true scutulum. This stage is rarely observed, for it soon disappears. As the scutulum grows, it assumes the form of a convexoconcave meniscus, then its upper face becomes umbilicate, and its diameter increases. The horny layer exfoliates, often taking some of the upper portion of the scutulum with it. This allows the disintegration of the upper portion of the scutulum, composed of dead leucocytes, giving it the umbilicate appearance. The scutulum now consists of an agglomeration of mycelium in a considerably enlarged hair follicle, surrounded below by leucocytes and their remains. It consists of three zones: the inner, surrounding the hair, is made up of a tangled mass of mycelium breaking up into arthospores; the middle zone of regular hyphae separated by portions of the horny layer of the epidermis; and the outer zone composed of hyphae perpendicular to the surface of the scutulum with some infiltrated leucocytes in the outermost portion. At the surface of the scutulum, the epidermis is intact, while the dermis below is somewhat infiltrated and sclerosed as in most lesions following chronic irritation. Sometimes the scutula remain small and distinct (favus urceolaris) or spread and partially coalesce (favus scutiformis) or agglomerate into heaps (favus squarrosus). Sometimes they form a flat crust, superficially resembling impetiginous or seborrheic lesions, but if this is partially rubbed off, the sulphur yellow lower portions of the scutula may still be seen. Cases of several months' standing develop a characteristic odor, similar to that of a mouse nest.

The very small scutula of some cases of favus are usually overlooked, while in some cases of the impetiginous variety they are not found. The pityriasiform type has few scales which may be large and of variable form. Under the scales, the bottom of the lesion is red, similar to that of psoriasis, with a surface of small thin yellowish scales. The superficial scales are easily detached while the deeper ones, in contact with the hair, are adherent, and cover a dry surface. Such lesions might easily be mistaken for pityriasis, dry eczema, or psoriasis, were it not for the dry, gray, discolored hairs on the surface, which are also typical of favus. A close search in these lesions will show very small scutula, about the size of a pinhead. Almost always in old affections small scar alopecias may be found. The mouse-gray surface of the hair, which offers little resistance to traction, is also characteristic. These lesions, being of long duration, spread very slowly but never diminish. They are relatively more common among the Moslem population of Algeria than in Western Europe (Catanei 1933).

In the impetiginous type, there are only two or three small lesions covered by an amber yellow fragile crust. Since no scutula are visible, it may be distinguished from impetigo by the long duration in the same place, by the beginning of a scar, and by the favic hairs caught in the crust.

While the hair is as important as the scutulum in diagnosis, its infection is not evident in the early stages. Infection occurs in the root and the fungus must grow up through the hair to a height above the scutulum before changes in the hair are visible. This process takes 3-4 months, after which the hair shows a characteristic appearance for several years until finally it is expelled by scar formation in the follicle. The hair is a dull, powdery gray, and dry, quite different from a hair normally becoming white with age, and its length rarely exceeds a few centimeters. While it is a little more fragile than normal hair, it is not so fragile that one is unable to epilate it. When the hair is crushed, it readily splits longitudinally like the strands of retted hemp. In microscopic preparations, the fungus is absent from the bulb. Tiny air bubbles adhere to the surface of the hairs and long slender ones are seen within it, probably because of infiltration of air into the spaces left by the dead hyphae (Fig. 75). It is possible that this is what gives the hair its gray color. There are relatively few hyphae in any one hair, so that the structure of the hair is always clearly visible between them. These hyphae are flexuous and wavy, somewhat variable in diameter, dichotomous with the branches growing downward toward the bulb, the older portions farthest from the bulb, the region of active growth being where the hair passes the horny layer, never in the depths of the follicle or in the bulb. Sometimes the hyphae are slender enough to suggest those of *Ectotrichophyton*, but they never produce any spores outside the hair.

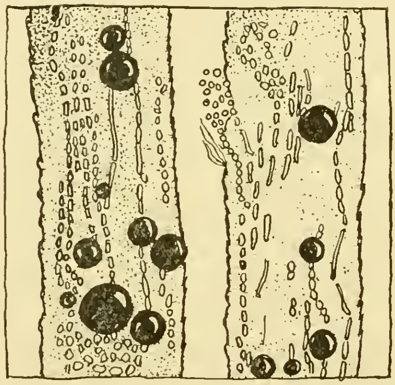

Fig. 75.—Section through hair from a case of favus, caused by *Achorion Schoenleini*, showing mycelium and air spaces in the hair, as well as attached air bubbles. (After Sabouraud 1910.)

In very old cases, the aspect of the lesions changes very much, appearing as rows of folliculites surrounding a scar alopecia. At first the scars appear as isolated points between active lesions still covered by scutula, which diminish in size and disappear. The follicle occupied by an infected hair is marked only by a persistent red point. Increasingly the scar areas appear and become confluent, leaving islets of healthy hair and hair in the early stages of infection. Growth is so slow, however, that Sabouraud reports a case of a man of 80 still showing active lesions at the border of his hair although the disease was contracted in infancy. The process of scar formation is never fast enough to eradicate the fungus completely.

While in some cases favus seems confined to the scalp, in others it spreads to the glabrous areas. It appears for a time as circular areas with deep red margins (a phase present but brief and usually overlooked in the hair). It may soon disappear spontaneously and completely, or it may give rise to favic scutula if the resistance of the host is slight. If scutula develop, the lesions will not disappear without treatment but will continue to increase in size, become confluent, and form huge crusts unless they are removed by friction of the clothing or by scratching. Sometimes favus remains localized for a long time on one portion of the body, the scrotum being a common site, where the scutula grow quite rapidly. Patients exhibiting generalized infection often seem to be mentally deficient, generally showing an inferiority complex.

Finally, favus rarely attacks the nails (1-3% of favus cases). The lesion begins by showing lenticular maize yellow spots analogous to ungual psoriatic lesions. These spots are thickenings of the nail formed by the stratified scales with numerous hyphae. Then the external layers crack and the nail substance becomes friable, scales off, and leaves the nail deformed. Sometimes the external layers are more resistant. In this case the nail is uniformly thickened and undergoes a caseous degeneration. The nail is elevated above its bed or the invaded parts remain dry and are eliminated as a powder. The fungus grows only in the horny layer, never penetrating the epidermal cells below the horny layer.

In South Africa, a favoid condition of the scalp needs further study. This condition, generally known as *wit kop, dikwakwadi,* or *white head,* seems confined to the syphilitic native, particularly in British Bechuanaland. The condition begins as slightly raised isolated macules irregular in distribution without reference to hair follicles. They pass from papule to pustule with very little inflammation. By the time the pustule has developed, coalescence has begun. The crust is dry and friable. It seems to develop in layers which are added to from below. These are firmly bound together and do not become detached as in impetigo. Their color is dirty white, but may be dead white or in old cases have a yellowish tinge. The hair soon suffers; it becomes dry, brittle, and lustreless, and then falls. The condition involves the whole scalp, except the fringe about the neck and in front of the ears. The surface of the crust may be smooth or undulating, the outer layers friable, the inner firmly adherent, attached to the scalp, often stony hard. When the crust is raised, a red noninflamed denuded surface is revealed, practically devoid of serous or sanguineous exudate. There is no local irritation. It is said to be confined to heredosyphilitic cases (Fraser 1922). The etiology is still in question, Fraser attributing it to *Treponema pallidum*, while Mitchell & Robertson (1915) attribute it to *Achorion*.

The second most clearly distinguished type of lesion of the hair is that of tinea tonsurans, in which the infected hairs are so weakened that they break off a few millimeters above the scalp, leaving an area which looks as if the hair had been clipped or shaved, hence the name. Two genera of fungi are responsible for this condition and since clinical details vary in many respects in the two genera, they will be discussed separately.

In the first type, that caused by species of *Microsporum,* the hair breaks three or four millimeters from the skin and is surrounded by a thin white sheath of fungus spores, 2-4μ in diameter, packed closely together without apparent order. Generally the lesion is covered with a layer of gray scales. It begins as a small erythematous spot whose circular border is scarcely redder than the center. At first the hair appears normal. In a few days the lesion pales and becomes furfuraceous, while the hair begins to show its characteristic appearance. Each hair is incased at its base for about 3 mm. by a grayish white sheath, which seems to be a prolongation of the follicular epidermis (Fig. 76). A little later the hairs break and the white lamellar scales appear. Practically every hair in the lesion is attacked, in strong contrast to lesions caused by *Trichophyton* in which many normal hairs are found within the infected area. Unless treatment has intervened, the infected hairs become grayish, discolored, and are very easily epilated. Sometimes the lesions remain dry; in other cases they gradually take on a seborrheic appearance when the scales agglomerate in a thick layer of a yellowish color and greasy consistency. The hairs become embedded in this mass. The maximum diameter of an infected area is 4-6 cm. The infection, however, may be carried by a broken hair to a new spot by autoinoculation. This may be repeated until five or six lesions have been formed. As these spread they may coalesce, usually leaving triangles of uninfected hairs. Rarely many lesions may form by autoinoculation until most of the scalp is invaded. When a lesion stops spreading, the vitality of the fungus seems to be exhausted and it is rarely capable of further autoinoculation. Careful epilation at this stage will usually remove the bulb with the hair, and if new hair grows, it will be uninfected. Sometimes the infected hairs are gradually shed and after a variable time, lanugo appears on the denuded surface and then normal hairs grow. This denuded state is to be differentiated from a similar state which other types

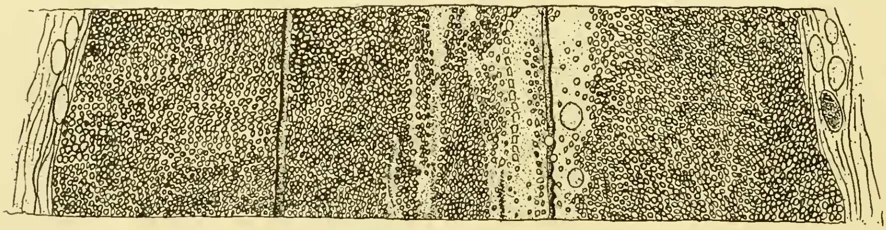

Fig. 76.—Section through hair from a case of tinea tonsurans microsporica, caused by a species of *Microsporum.* (After Sabouraud 1910.)

of tinea tonsurans may show after an inflammatory phase. Growth of the new hair is much slower than that of normal hair so that the site of the lesion can long be distinguished by the smaller number of hairs per square centimeter. Microsporic tinea tonsurans is much more common on boys than girls, but it is sufficiently contagious for practically all the other members of a family who are of a suitable age, to contract the disease from the one originally infected. It spreads easily in primary schools, and only the strictest isolation and inspection can prevent its running for several years.

In the early stage an examination of the horny layer of the epidermis shows mycelium 1-3μ in diameter, hyphae curved and undulate, with many short lateral branches, septa rarely visible in unstained preparations. When the mycelium reaches the mouth of a follicle, it follows the follicular epidermis downward. It then grows out into the space between the epidermis and the hair, forming a mycelial mass (suggesting an early stage of a favic scutulum), composed of hyphae, 6-7 cells, each 12-15μ long, and some loose spores. When the hair is reached, some hyphae penetrate the hair itself and grow downward in flexuous curves (nearly straight in very old hairs after the tendency to heal has begun). Sometimes they nearly fill the hair with their bifurcations. Other hyphae grow downward along the outside of the hair from which hyphal branches grow outward to form the spore layer which is so characteristic in these lesions. The spores apparently arise by frequent dichotomy and cell division in the hyphae, producing compact masses of spores on the outside of the hair. The cells are somewhat deformed by mutual pressure. It is also probable that branches from the hyphae within the hair grow outward to contribute to this spore sheath.

In handling the hairs, this spore sheath is often knocked off and the hair, which then appears dull grayish yellow, under the microscope shows only a few scattered spores over its surface which is roughened and cracked like the bark of an elm. Within the hair, a few flexuous irregularly septate hyphae, 2-3μ in diameter, may be seen. The spore sheath penetrates the follicle only one or two millimeters, thinning out toward the root. On the root itself only a few scattered islets of spores may be seen. The hyphae within the hair become increasingly abundant, ending in a fringe (of Adamson). Rarely the eyelids and lashes are attacked (Arijewitsch 1930).

In the second type of tinea tonsurans caused by *Trichophyton*, the erythematous spot disappears very quickly and is followed by a scaly crust, about a millimeter thick, of yellowish scales with adherent hairs. The lesions are abundant (often over 100 to a scalp), small and very scattered over the surface, often only 2 or 3 hairs being infected in each lesion. The infection often spreads by autoinoculation to the glabrous skin where it either produces small, amorphous, abortive, erythematous patches which soon disappear, or more rarely a circinate lesion. In the first or *Sabouraudia* subtype caused by *T. Sabouraudi* (*T. acuminatum*) the hair breaks off sharply at the follicular orifice and is thick and black. It resembles a comedo in appearance. Comparatively few normal hairs are found in the lesion. In the second or *Malmstenia* subtype caused by *T. tonsurans,* the hair is folded and refolded in the scale. It is yellowish gray and extends about 5 mm. beyond the scalp. Many normal hairs are scattered over the infected area. In more atypical cases, the hair may be straight, yellowish gray, 2-3 mm. above the scalp, suggesting the microsporic type but lacking the spore sheath, or the lesions may be covered with a thick layer of impetiginous crusts, or half impetiginous, half fat.

Some lesions are slightly infiltrated while others show no erythema but large black hairs, broken in the skin and enlarged so that the follicle is protruding. The follicular orifices may be marked by an isolated red point, the beginning of folliculitis, or the folliculitis may become suppurative and each hair the center of a pustule, the whole lesion forming an elevated, red, ulcerated plaque, and giving the appearance of a true kerion, which may be benign or severe and terminate with or without a scar. In these latter variations it may be found on adults, but it is predominantly a disease of children. The more active the suppuration, the shorter the probable duration of the disease. The dry lesions often last for several years if not treated; the lesions, marked by red points where the follicle is invaded, disappear in 6-7 months while the suppurative lesions are cured in 6-8 weeks. Although growth of new hair is very slow, bald areas are rare following tinea tonsurans except in scar formation following kerion and where the careless application of irritants to secure prompt depilation has caused irreparable damage.

On the infected hair the hyphae are parallel, composed of isodiametric cells, often called spores by dermatologists. These cells may be large, about 8μ, or small, about 3μ in diameter, spherical, ovoid, or cylindric. Hyphal branching is rare and strictly dichotomous, the forks pointing downward. When the hyphae are confined to the interior of the hair, as is usual in tinea tonsurans (Fig. 77, *1*), the fungus is said to belong to the *Trichophyton* endothrix type. When the fungus produces a mass of mycelium surrounding the hair without penetrating it, as frequently occurs in lesions of the beard, the fungus is said to belong to the *Trichophyton* ectothrix type (Fig. 77, *2*). These types are alike in the very young stages. In a third type the mycelium is mostly within the hair as in the true *T.* endothrix type, but a few hyphae still grow along the outside of the hair; this is called the *Trichophyton* neoendothrix type. The second type is further differentiated into the large spored type with spores 5-8μ in diameter and a small spored type, with cells 3-4μ, the former sometimes referred to as *T.* ectothrix megaspore (often shortened to *T.* ectothrix) and *T.* ectothrix microsporoid (often shortened by French writers to *T.* microïde type).

As in the *Microsporum* type, the horny layer of the epidermis is first invaded, the hyphae growing along this until the mouth of a follicle is reached. They then grow along the follicular epidermis, producing a slight mycelial collar. Penetration of the hair is prompt and similar to that in *Microsporum.* As soon as a hyphae has penetrated, it branches dichotomously and grows downward. While it is just under the cuticle of the hair, it is easily stained, but as it penetrates deeper, it remains unstained with the usual dyes. The hyphae gradually fill the hair and render it very fragile so that it breaks at the neck of the bulb.

In the neoendothrix type, the conditions found in the early stages persist a long time, about one quarter of the hairs at a given time showing hyphae on the outside of the hair or between the hair and the wall of the follicle. This persistence of the early stage of infection occurs in those species which normally infect domestic animals and only occasionally are found in man. Similarly in the *Neomicrosporum* group, the external hyphae which form the spore sheath in the early stages persist much longer than in the *Eumicrosporum* group, which includes *M. Audouini.*

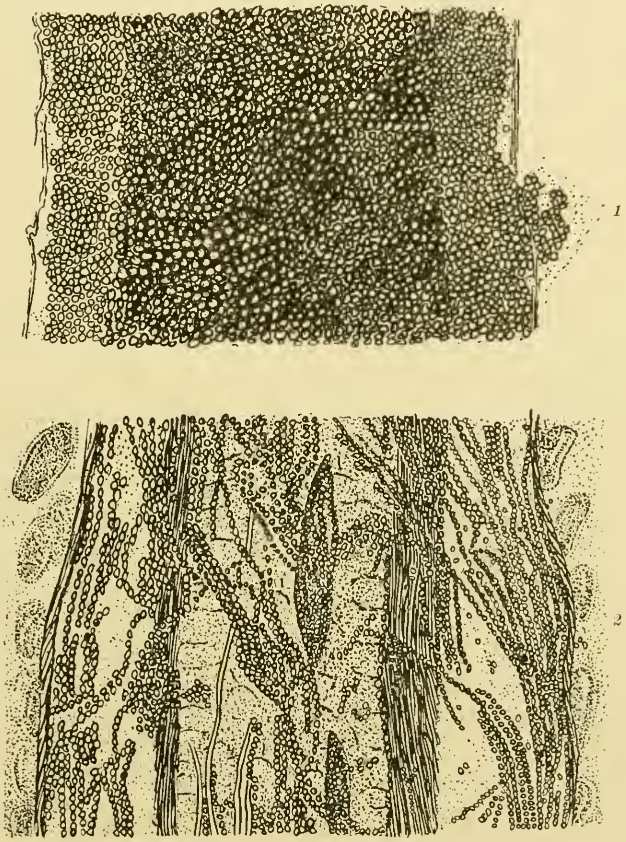

Fig. 77.—Section through hair from case of tinea tonsurans. *1,* caused by species of *Trichophyton;* *2,* caused by Ectotrichophyton. (After Sabouraud.)

In the ectothrix group there are so many variations in the different species in respect to the form and dimensions of the cells, the regularity of the arrangement, and the proportion of the hyphae outside the hair, that generalization is difficult. In *Ectotrichophyton* and *Favotrichophyton* (the microïde group), all the species are pyogenic, all invade the hair as slender hyphae, with septa farther apart, forming a sheath outside the hair made up of small spores, 3-4μ in diameter, spore chains and slender nonseptate hyphae which float in the microscopic preparation as fragments 15-20μ long. Thus it will be seen that clinically these species have many resemblances to *Microsporum*. They also have many cultural and morphologic characters in common with *Microsporum* and are placed in that genus by several workers, from Gruby to Guiart & Grigorakis. They are very rare in cases of tinea tonsurans, although common in kerion.

The beard is quite susceptible to fungus infection. The moustache is rarely attacked and the nasal hairs never, reversing the order in bacterial infections, which are more common in nasal hairs and in the moustache. The dry type of lesion corresponds very closely to tinea tonsurans of the scalp of the *Trichophyton* type. The commoner type is sycosis which consists of nodular suppurations, intradermic, disseminated, sometimes below the exudative and suppurative lesions of the surface and sometimes not. It may be the primary infection or it may follow an infection of the dry type. Sometimes the nodules are hypodermic and cannot be evacuated by pressure. At other times they are more superficial, and pressure causes evacuation of pus with or without the infected hair. Sometimes they form small elevated cones with the pus under a thin layer of epidermis. The latter type disappears quickly, while the deeper types may last for several months.

The kerion is a round or oval area of contiguous folliculites. The surface of the lesion is slightly elevated, with follicular abcesses soon visible and open, transforming the follicles into purulent pits from which suppuration evacuates the dead hair. A kerion may have a hemispheric form, or may protrude a centimeter or more, forming a soft tumor analogous to botryomycosis but not pedicelled as in that case. Epilation with forceps removes the dead hairs which the inflammatory process has detached from their roots. Finally, a layer of pus is formed under the whole kerion which becomes soft, and may be detached by sphacelation. It leaves a scar the size and shape of the detached kerion. In other cases, the multiple kerions coalesce more or less and below them form abscesses of varying size which may even survive the superficial lesions. When, after several weeks, they open, they may contain a serous and oily liquid analogous to the synovial fluid.

Finally, in the very rare cases where the fungus invades the dermis we find a granuloma, first clinically differentiated by Majocchi (1883); more recently by Oro (1926). After a short herpetic stage of desquamation, alopecia occurs, the skin assumes a slight rose color, and becomes papuloid. The granuloma slowly develops to the size of a nut or bean, the neoplastic stage. Then degeneration sets in, the nodules soften and become reddish violet. The lesions are found in the dermis media and hypodermis and are formed by a granulation tissue, the center consisting of a hair fragment with spores, the middle zone formed by a layer of giant cells, and the outer layer formed by granulation cells mixed with endothelial cells and with mono- and polynuclear leucocytes, in the midst of which some reticulate, supporting fibrillae are scarcely visible; the plasma cells are frequently numerous. It differs from kerion in being slow in development and very chronic.

Since the characters of the giant colony seem quite distinctive and have been much used in systematic studies, they may be reviewed briefly, although for details the reader is referred to the descriptions of the various species. Up to the present, the aim has been to cultivate the species on Sabouraud's maltose or glucose agar or on some modification which will produce closely similar colonies, since some of the luxuriance of the colonies, upon which Sabouraud's original descriptions were based, seems to have been due to impurities in his crude maltose and glucose. In general, the species which are more restricted as to host and method of parasitism are less luxuriant in growth upon artificial media, while those growing easily on a large variety of hosts, and producing more active suppuration, are luxuriant.

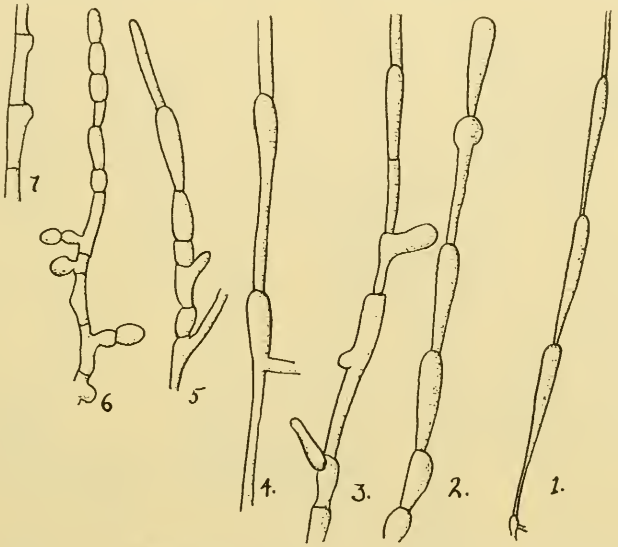

Fig. 78.—Mycelium. *1, Microsporum Audouini; 2, Megatrichophyton equinum; 3, M. ferrugineum; 4, Favotrichophyton ochraceum; 5, Endodermophyton tropicale; 6, Acladium Castellanii.* (After Ota & Langeron 1923.)

The colony may be either crateriform, acuminate, or cerebriform. Characteristic and conspicuous radial furrows or folds are common, while concentric furrows or zones are rare. The appearance of the surface is largely dependent on the nature of the reproductive organs produced. Sterile mycelium is very loose and cottony as seen in pleomorphic mycelia (see p. 456). Somewhat denser and feltlike is the mycelium when the fusiform spores are predominant. Where the aleurospores are predominant, the surface is powdery to chalky. When only chlamydospores are produced, the colony is moist, glabrous, and almost yeastlike.

The mycelium of the less degenerate forms is usually dimorphic. The primary mycelium which bears the closterospore or the chlamydospore, is septate, relatively coarse, 4-5μ in diameter, with 5 nuclei in mature cells, while the mycelium which bears the chlamydospore is slender. In the primary mycelium the cells may vary in shape from clavate to that of a tennis racquet (Fig. 78). This peculiarity is not confined to the dermatophytes but is also found in some of the Endomycetales. Sometimes the terminal cells only become clavate (the terminal clubs of Sabouraud), or if a number of short terminal branches swell at the same time, they form the favic candelabra which are often abundant and quite characteristic of *A. Schoenleini* on the standard media. These have been generally interpreted as forms induced by cultivation on unsuitable media (*formes à souffrance*) or, more recently by Grigorakis as a final stage in the degeneration of reproductive organs following cultivation on artificial media. In some species typical curved hyphae bear on one side short projections which give the hyphae a pectinate or denticulate appearance (Fig. 79, *15-19*). Some authors regard these as degenerate forms of those pectinate or denticulate hyphae which in *Ctenomyces* of the Gymnoascaceae ornament the hyphal tangles bearing the asci. Grigorakis regards them as the shriveled remains resulting from the formation of aleurospores or of lateral chlamydospores. In some cases they may also result from unfavorable environmental conditions.

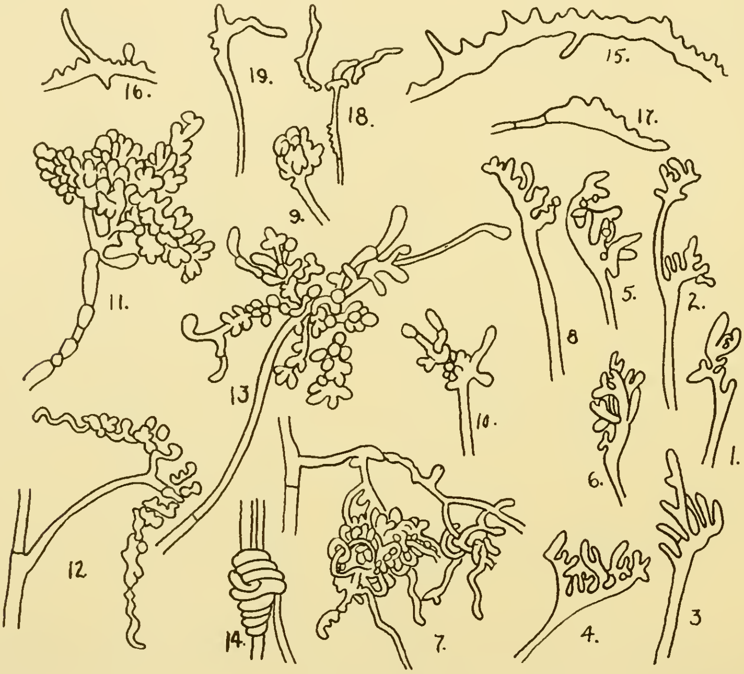

Fig. 79.—Nodular organs: *1, 2, Trichophyton* cas du Horta; *3-14, Megatrichophyton equinum.* Pectinate organs; *15, 16, M. equinum; 17, Microsporum canis; 18, M. umbonatum; 19, Trichophyton* cas du Horta. (After Ota & Langeron 1923.)

On the other hand, the so-called nodular organs seem to be an initial stage in the degeneration of the Gymnoascaceous fructification (Fig. 79, *1-14*). Sometimes they seem to be formed by outgrowths of the pectinations of the pectinate hyphae, or as a tangle of hyphae resulting from a number of short branches near the tip of a hypha; or, in other cases, of a dense tangle where the structure cannot be distinguished. These organs, however, do not develop further and their significance is still somewhat in doubt.

In the genus *Ectotrichophyton,* the close dense spirals are thought to be closely related to similar spiral ornaments in *Myxotrichum* of the Gymnoascaceae. It should be remembered however that under certain environmental conditions a similar coiling may occur in wholly unrelated groups. Although in itself it would be of little significance, as an additional bit of evidence the presence of these spiral hyphae supports the argument for the primitiveness of *Ectotrichophyton.*

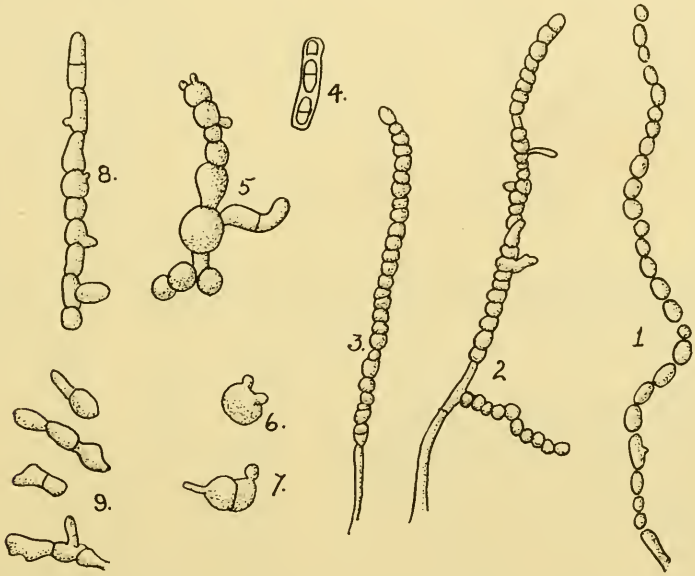

Fig. 80.—Arthrospores. *1, Trichophyton tonsurans; 2-7, Favotrichophyton violaceum; 8, 9, Endodermophyton concentricum.* (After Ota & Langeron 1923.)

From the description of Grigorakis, who seems to have worked wholly with mass cultures, the origin of the secondary mycelium is not at all clear. Apparently it is produced from aleurospores. Nothing is definitely stated as to the number of nuclei per cell, but judging from Grigorakis' figures, the mycelium would seem to be either uni- or binucleate, at least with fewer nuclei than the primary mycelium. Fusion of aleurospores prior to germination has been noted in *Ectotrichophyton* but Grigorakis states there is no nuclear fusion. Probably this represents a degeneration phenomenon such as we frequently find in the yeasts where unsuccessful attempts at nuclear fusion are made. Also the full significance of the hyphal fusions shown by Davidson, Dowding & Buller (1932) is not yet clear, although they seem to be useful in determining species. In the series tried, these authors were unable to find any interspecific fusions. Whether there is a relationship between these hyphal fusions and the phenomenon of heterothallism, only further research will show.

When the conditions for growth become unfavorable, arthrospores are regularly formed both in the lesions and in culture (Fig. 80). They are usually rows of undifferentiated hyphal cells which aid in dissemination and in carrying the fungus over a period of unfavorable conditions. They have no morphologic significance as they occur in many wholly unrelated groups of fungi.

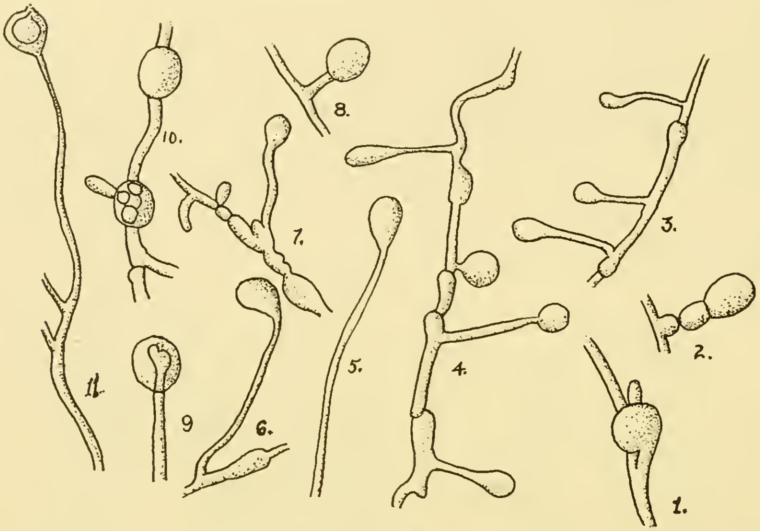

Fig. 81.—Pedicellate chlamydospores. *1, Megatrichophyton equinum; 2, 3, Achorion Schoenleini; 4, Favotrichophyton ochraceum; 5, Favotrichophyton album; 6, Trichophyton plicatile; 7, Trichophyton flavum; 8, 9, Microsporum ferrugineum; 10, 11, Trichophyton* cas tu Horta. (After Ota & Langeron 1923.)

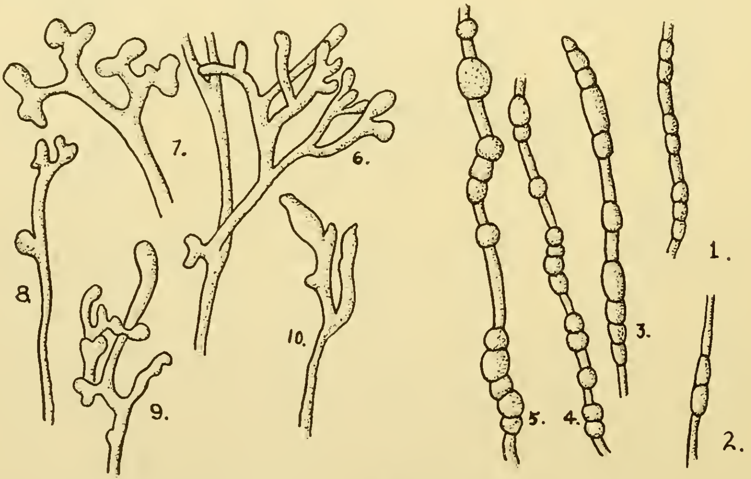

Fig. 82.—Intercalary chlamydospores: *1, Megatrichophyton equinum; 2, Favotrichophyton violaceum; 3, 4, M. roseum* var. *vinosum; 5, Trichophyton tonsurans.* Hyphal tips: *6, 7, Achorion Schoenleini; 8, 9, Favotrichophyton album; 10, Megatrichophyton equinum.* (After Ota & Langeron 1923.)

The so-called endoconidium (not to be confused with a true endoconidium which is altogether different in origin) is an arthrospore with a slightly thickened wall.

The term "chlamydospore" has been used for many different types of spore, most of which have a thickened wall and serve, as do the arthrospores, to carry the fungus over unfavorable environmental conditions. The so-called lateral chlamydospores are really terminal chlamydospores (Fig. 81) formed on short branches, the terminal portions of which are the chlamydospores, the remainder forming the pedicels which may or may not be separate cells. The intercalary chlamydospore represents a further degeneration where a swollen intercalary cell functions as a chlamydospore (Fig. 82).

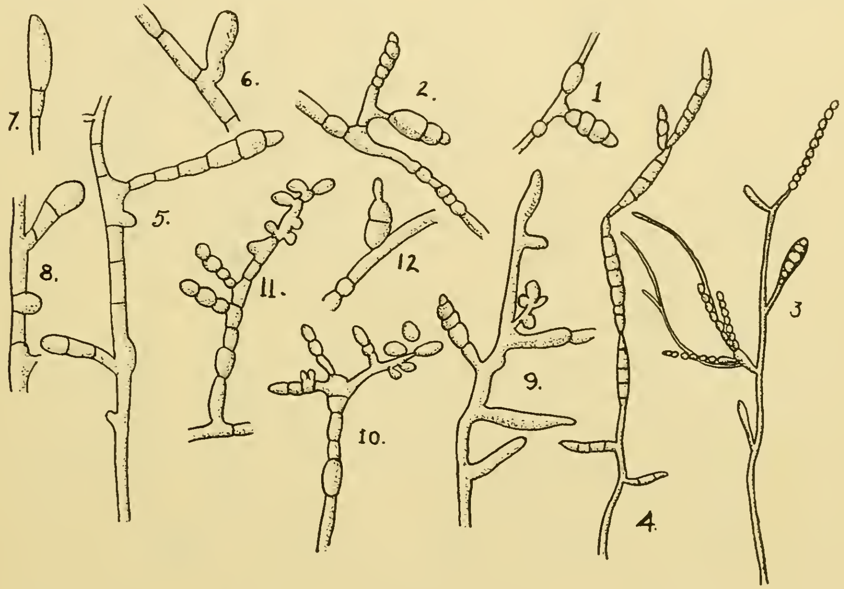

Fig. 83.—Showing closterospores and their transition to chlamydospores. *1, 2, Favotrichophyton violaceum; 3, 4, Megatrichophyton roseum* var. *vinosum; 5, Achorion Schoenleini; 6-8, Endodermophyton tropicale; 9, Trichophyton flavum; 10-12, Trichophyton tonsurans.* (After Ota & Langeron 1923.)

The **closterospore** is the most typical organ of the group, although its morphologic significance is obscure. It may be a wholly asexual reproductive spore, such as the phragmospore which it resembles in form. Probably when the life history of the whole group of these organisms is more fully known, it will be found homologous to some structure connected with the sexual act, such as a degenerated ascogonium or antheridium. It is a multinucleate structure suggesting in form the gametangium of the primitive Endomycetales (*Spermophthora*). It soon divides into 2-5 cells (Fig. 83), each containing 2-5 nuclei. On germination the number of nuclei in each cell multiplies rapidly while many germ tubes are produced in a manner suggestive of the multiplication of nuclei and the development of germ tubes in an ascogonium. As we follow the degeneration stages either of a single culture on unsuitable media, or of the series connected with increasing specialization for parasitism, we find that as the closterospore is less highly developed (Fig. 83), the so-called chlamydospores increase in numbers and each (containing 2-5 nuclei) functions as a single cell of a closterospore.

The aleurospore seems homologous in function to the conidium of the Gymnoascaceae, although we can trace a degeneration in its formation from a well-defined spore borne on a denticulation, to a spore which might equally well be an initial of a branch transformed into a resting spore (Fig. 84). Sometimes the sporiferous hypha is partially differentiated into a thyrsiform conidiophore, while in other species there seems to be no differentiation from the vegetative hyphae. Or perhaps the aleurospore represents a very degenerate ascus where meiosis has failed. The form of the thyrsus resembles the ascogenous hyphae of the Gymnoascaceae; the aleurospore is always uninucleate; on germination its nucleus divides only two or three times before the daughter nuclei migrate into the germ tube. Only uni- or binucleate secondary mycelium develops, instead of the multinucleate mycelium, with nuclear division far in advance of septal formation, as in the primary mycelium.

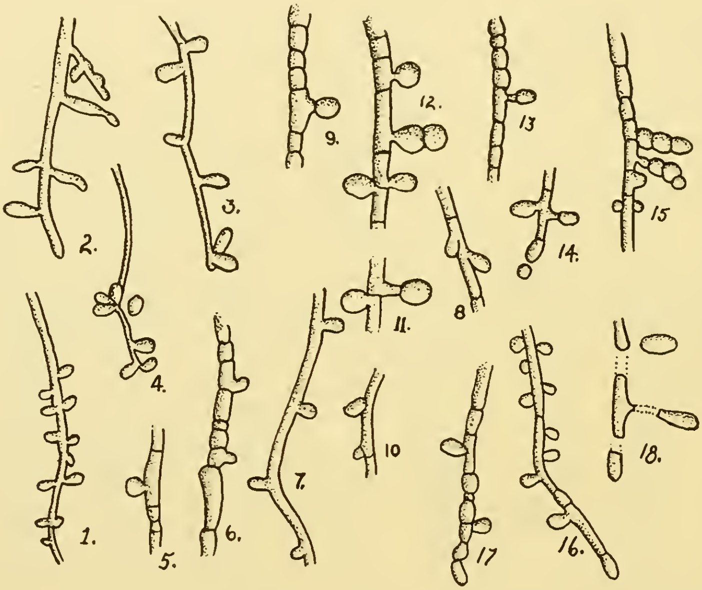

Fig. 84.—Aleurospores. *1, Megatrichophyton roseum* var. *vinosum; 2, Ectotrichophyton lacticolor; 3, Achorion muris; 4, Trichophyton tonsurans; 5, Endodermophyton tropicale; 6, Favotrichophyton violaceum; 7, Achorion Schoenleini; 8, Favotrichophyton ochraceum; 9, Acladium Castellanii; 10, Microsporum ferrugineum; 11, 12, Ectotrichophyton mentagrophytes.* (After Ota & Langeron 1923.)

In this connection it may also be noted that in Nannizzi's experiments *Ectotrichophyton mentagrophytes (Trichophyton gypseum asteroides), E. mentagrophytes* var. *radiolatum (T. radiolatum), E. felineum (T. felineum)* and *E. felineum* var. *denticulatum (T. denticulatum)* produced structures resembling the fructifications of the Gymnoascaceae where aleurospores were found instead of asci. These structures are also similar to the pycnia of *Ctenomyces* *serratus.* On the other hand, it must be admitted that Nannizzi reports closterospores and aleurospores formed by known Gymnoascaceae when grown on hair, feathers, and bones. Unfortunately, he omits cytologic data.

Working with single spore cultures, we must investigate with greater completeness the nuclear history of many more species, before we have a clear notion of phylogeny. This is especially true in degenerating series where often the extremes of degeneration are more common and first studied. Such was the case of the yeasts for many years. The common beer yeast represents the parthenogenetic end member of a long series whose stages have been so clearly described by Guilliermond during the present century.

Spring (1931) unsuccessfully attempted to mate strains of three common species to see if they would produce ascocarps. Probably heterothallism is not important in this group. Grigorakis (1931) has secured curious aggregations of hyphae with gelification of the walls and coiling of one filament about another as in perithecial formation when *Microsporum felineum* and *Ectotrichophyton mentagrophytes (Spirallia asteroides)* were grown on media containing glycerol.

Variations and So-Called Mutants.—Brierley (1929) has summarized the literature on variation in bacteria and fungi very thoroughly. Most of the so-called mutations are not an alteration in the fundamental nature of the germ plasm, usually in a single gene, but are only the result of a recombination of characters already present. It is possible that these changes may result from the loss or the rearrangement of factors when a character is determined by multiple factors. During the numerous vegetative mitoses there is the possibility of an unequal division of chromatin which would alter the character of that portion of the mycelium and of the spores subsequently formed in it. More recent literature is well reviewed by Emmons (1932) in connection with his study of similar phenomena in *Achorion gypseum* and *Ectotrichophyton mentagrophytes (T. gypseum).* Unfortunately, he has not accompanied his descriptions of cultural characters by cytologic information. Most of his variants arose from a flask culture on horn. Since his variants arose from single spore cultures, they are free from the criticism of those of Biltris (1929) who worked with mass cultures. In most of Emmons' variants, sectors reverting to the parent type were produced. On the other hand, the variant remained constant for twelve transfers (interval not stated) and showed no trace of pleomorphism in 8 months. He could find no evidence of myxochimaeras, nor of cross-fertilization.

In Emmons' report on his Strain III of his *T. gypseum* it seems probable that he was dealing with *Ectotrichophyton farinulentum* rather than *E. mentagrophytes.* In this species and *E. lacticolor,* ultraviolet radiation may have been a factor, since variants developed only after exposure to it. It may not be the sole factor, however, since many other cultures similarly exposed, developed normally. In *E. farinulentum,* color variants, both red and yellow, arose while in *E. lacticolor*, the ultraviolet radiation seemed to stimulate the production of nodular organs while depressing the development of aleurospores and spirals.

In *E. farinulentum,* a very curious variant developed in a blood agar slant, where the aleurospores were produced in very large numbers but never matured. Finally, the whole mass formed a clump, suggestive of a nodular organ. The mycelium remained of normal diameter, thus differentiating it from a pleomorphic mycelium.

Pleomorphism.—While some other groups of fungi show slight changes after continued cultivation on various media, these are much less spectacular than those of the dermatophytes. These changes should be clearly distinguished from the ordinary changes which are common to all fungi. In culture any fungus undergoes changes in appearance from youth through the adult, or normal, form to senile degeneration. For example, if the giant colony normally forms concentric folds, these may be contorted by variable growth rates in the senile colony. Similarly a colony which is only crackled in the normal adult form may be deeply fissured in the senile stage. The juvenile form reappears when the spores from old cultures are transferred to fresh, suitable media, and it repeats the same cycle of changes.

In true pleomorphism, subcultures retain all the characteristics of the pleomorphic mycelium and do not revert to the juvenile stage. In most dermatophytes which have been growing from 4 to 6 weeks on sugar-containing media, there appears, usually at the point of inoculation, sometimes elsewhere on the colony, a delicate tuft of white mycelium which gradually spreads over the surface like a contaminating organism. This may even grow beyond the edge of the colony. Microscopic examination shows it to be altogether different from the normal mycelium of the original colony. It usually bears much fewer spores, closterospores and chlamydospores being absent, often aleurospores also. When this pleomorphic mycelium is transferred to fresh media, it continues to exhibit only the characters of the pleomorphic mycelium, although it develops a different colony form (usually a smooth white disc). This condition appears to be irreversible.

In some cases, a loss of virulence accompanies this form of pleomorphism. In *Ectotrichophyton mentagrophytes* var. *radiolatum* (Catanei 1930), the initial inoculation of pleomorphic mycelium produced the typical lesion of this species in a guinea pig, but the pleomorphic mycelium isolated from this lesion produced an epidermal lesion without invading the hair. On the other hand, inoculation directly from guinea pig to guinea pig by infected hair from a lesion caused by pleomorphic mycelium continued to produce a typical lesion, without attenuation. From pleomorphic mycelium of *Microsporum felineum,* Langeron and Talice (1930) obtained a typical lesion and reisolated only pleomorphic mycelium from the lesion. In the pleomorphic mycelium of *Trichophyton Sabouraudi (T. acuminatum),* a species which very rarely becomes pleomorphic, Catanei (1931) found decreased pathogenicity for the guinea pig and reisolated pleomorphic mycelium from the lesion.

The pleomorphic mycelium looks so different from that in a freshly isolated colony that unless one is familiar with the early stages in the development of such a colony, there is danger of regarding the freshly isolated colony as belonging to a new species. Since the pleomorphic mycelia of different species resemble each other much more than the normal mycelia of those cultures, some have thought that different species were identical where their pleomorphic mycelia were the same, and that the differences in the normal mycelium were more or less accidental variations produced by environment. However, many species never become pleomorphic, and even the time of appearance of such mycelium under standard conditions seems to be a definite specific character.

Sabouraud (1910) raised the interesting question whether some of his species which show considerable degeneration, with loss of some spore forms without exhibiting further pleomorphism, may already be pleomorphic mycelia of other species which have become fixed and are producing lesions in animals without ever returning to their original form. Some of the recent work of Catanei and of Langeron & Talice would tend to confirm this hypothesis. Grigorakis elaborated this in his doctoral thesis in 1925, and based his classification largely upon this hypothesis, without producing experimental evidence beyond the isolation of pleomorphic mycelium of *Microsporum felineum* from lesions on a cat. He would arrange the species in genera on the basis of the stage of degradation shown in primary cultures without regard to the lesion provoked or organs produced on other media than Sabouraud test agar. It is possible that the future will see reductions of some of our present species to synonymy on the basis of Sabouraud's hypothesis, but this should be done only after a very careful study of the life history and cytology of both organisms, the nature of the lesions produced by normal and pleomorphic mycelium of both organisms on their normal hosts as well as on the usual guinea pig, and their microscopic morphology in and configuration of their giant colonies on a great variety of media, including both some of the animal products proposed by Nannizzi and the higher carbohydrate and dung media revived by Langeron & Milochevitch, as well as the usual laboratory media.

Phylogeny.—Perhaps the most primitive group of the dermatophytes is that represented by the genus *Pinoyella,* whose taxonomic position is not yet altogether clear. It has only been found on the glabrous skin of old world monkeys but is inoculable to guinea pigs where it causes an inflammatory lesion of the ectoendothrix type. The closterospores are incompletely 4-6 locular, coenocytic, germinating by a single uninucleate hypha from each locule, or each locule may form a separate uninucleate endospore which is ejected from the end of the closterospore, producing on germination uninucleate secondary mycelium with uninucleate aleurospores. The incompletely divided closterospore may represent a gametangium (ascus) of the general type of the Ascoideaceae in which the spore number is reduced, or the spore may even germinate before forming its wall. The resulting mycelium would then be homologous with uninucleate diploid ascogenous hyphae and the aleurospores with asci which are no longer functional. On the other hand, although less probable, the closterospore may represent an ascus and the aleurospore a uninucleate haploid conidium.

The next group from which the other genera seem to be derived by specialization both as to the organ attacked and as to the host, with the usual accompanying degeneration phenomena, is the genus *Ectotrichophyton* (*Trichophyton* microïde group). The lesion, starting in the horny layer of the epidermis, invades the hair follicle where it develops a sheath of mycelium and spores about the infected hair, suggesting the condition which we find more highly specialized in *Microsporum* and *Achorion.* It is easily inoculable into a wide range of experimental animals with little apparent specialization on any one host. The lesion is usually of the kerion or sycosis type accompanied by inflammation and suppuration. Closterospores and spiral ornamentation and nodular organs characterize the genus as a whole although, as we shall see later, the beginnings of specialization and consequent degeneration may be seen within the genus since any one or two organs may be absent on some of the usual media.

Closterospores are abundant only in the first few days of culture. Later and in subcultures, the relative number diminishes and the chlamydospores assume their functions. The nodular organs, which seem to have developed from degenerating closterospores, resemble in some species coiled chains of chlamydospores. Both closterospores and chlamydospores have 3-5 nuclei per cell and germinate by several germ-tubes after a rapid multiplication of nuclei. The cells of the closterospores are often subspheric and show forms transitional to the chlamydospores. The number of nuclei in the secondary mycelium is unknown but the aleurospores produced by it are uninucleate.

The most primitive species seems to be *Ectotrichophyton mentagrophytes* which produces practically all the organs characteristic of the dermatophytes, and infects a large number of hosts with kerion formation. *E. circuluscentricum* appears to be closely related but shows the beginnings of separation. From these species we have at least three diverging lines: *Achorion gypseum* which, by increasing development at the mouth of the hair follicle, paves the way for the *Achorion* line; the *E. farinulentum* line which continues the main trend of evolution but has left out the nodular organ; and the *E. lacticolor* line which has retained and even developed the nodular organ further only to lose it in *Favotrichophyton.*

In *Ectotrichophyton farinulentum* and in *E. scorteum* the spiral begins to disappear, being found only on pleomorphic mycelium; the primitive umbilicate colony gradually gives way to an umbo; both species seem restricted in distribution and in case of *E. scorteum,* the lesion is milder. The *Microsporum* line probably emerges at about this point. In the *E. griseum* and *E. erioton* group, the spirals have completely disappeared, the central area is often elevated and sometimes folded, and beginnings of the transition from the powdery or chalky to the woolly colony are found. In *E. multicolor* which form a transition to the *Trichophyton* line, the colony has become cerebriform and the lesion less inflammatory (see p. 500). The further development of this main line lies in *E. felineum* which produces closterospores and spirals on some of the complex carbohydrate media but has lost the power to produce them on Sabouraud media. The colony is wholly woolly or velvety but with long radial strands beyond the margin. The positions of *T. depressum, Achorion Arloingi, Aleurisma Guilliermondi,* and *T. chosenicum* are not clear, as these species have been inadequately described, but from such meager data as are available they appear to belong in this group.

Returning to the line which diverged in *E. lacticolor,* we find that the nodular organs are highly developed, and spirals are absent on Sabouraud media although still present on other media; the colony still has a depressed center. *E. granulosum* shows further degeneration by the disappearance of both closterospores and spirals on Sabouraud media although the latter are still produced on other media. The closterospore has apparently coiled and degenerated into the nodular organ, the individual cells of which germinate as do the cells of the closterospore; the colony with a crater and radial folds has been retained. Along with this degeneration, the organism has become adapted to the horse, rarely occurring as an evanescent lesion of the glabrous skin of man, although still easily inoculable into the guinea pig. In *E. eriotrephon* the spirals have completely disappeared, and the colony has become smooth, light gray and cerebriform on Sabouraud conservation agar. This species has become adapted in man, producing vesicular lesions and inoculable with difficulty to the guinea pig. It forms the transition to *Favotrichophyton.*

To return to the primitive stage represented by *Ectotrichophyton mentagrophytes* and *E. circuluscentricum,* we find a line remaining wholly in the epidermis, often producing vesicles but very rarely pustules, never kerion or sycosis. Perhaps the most primitive line within the genus *Epidermophyton* is the *E. salmoneum-persicolor* group, which produces papular lesions of the type of eczema marginatum in tinea cruris and vesicular lesions in the beard but no sycosis. Traces of nodular organs are found in *E. persicolor,* while the morphology of *E. salmoneum* is almost wholly unknown. *E. plurizoniforme* and *E. lanoroseum* seem to continue this line, with gradual degeneration of closterospore and aleurospore although both these spores are still present, the former becoming smaller and less abundant. Another line in the genus is *E. rubidum* in which degenerate nodular bodies and closterospores are still occasionally seen and chlamydospores are abundant. The lesion is in part pustular, the organism not being inoculable into guinea pig. In *E. rubrum* the closterospores are present and well developed, but no traces of spirals or nodular organs remain; the lesion is vesicular but not pustular, and the fungus is still inoculable into guinea pig. In *E. purpureum,* closterospores are rare and poorly developed; aleurospores are abundant. The group of species of *Epidermophyton* which never become pink or reddish, in which we find well-developed spiral hyphae and closterospores but no trace of nodular organs, is adapted to man and produces only a very evanescent lesion on experimental animals, without attacking the hair. *E. floccosum* still produces spirals on complex carbohydrate media although these are absent when it is grown on Sabouraud media; closterospores are abundant and somewhat specialized, thin-walled; this species is highly adapted to the inguinocrural region of man, not inoculable to guinea pig.

The final degeneration of this genus is reached in the *E. gypseum* group in which closterospores are absent, and the lesions are confined to the soles of the feet in man. In *E. gypseum* the colony is café-au-lait in color, crateriform and powdery, and becomes pleomorphic in 5 weeks; in *E. pedis*, the colony is yellowish cream color, disciform, with long velvet and becomes pleomorphic in 2-3 weeks; while in *E. niveum*, the colony is white, slightly elevated, with long velvet, and never pleomorphic.

The line of *Epidermophyton* is continued in *Endodermophyton* where practically only the chlamydospore and arthrospore are left and even these are rather degenerate. The lesion has been highly specialized on the dry portions of the epidermis without inflammation or even much pruritus. The epidermis loosens in triangular scales with the points inward and attached at the base in concentric circles; the cerebriform colonies are more or less moist and yellowish. The species of this genus are not easily inoculable into experimental animals.

Returning to the *E. lacticolor* line in *Ectotrichophyton*, where the nodular organ was retained and the closterospore was absent, let us turn our attention to *Favotrichophyton*. Here we find increasing specialization to host although the nature of the lesion is little changed from the milder types caused by *Ectotrichophyton*. Lesions on the normal host are apt to be less inflammatory and of longer duration than those produced on other hosts. As in *Epidermophyton*, *Favotrichophyton* may be polyphyletic in origin. The white species are perhaps related to *E. farinulentum* since in *F. singulare (F. album)*, Baudet reports having seen closterospores in one colony on barley, and in a member of this group on a goat. He (1932) reports abundant aleurospores on oleic acid medium, potato and carrots; in *F. Urenae*, Ochoterena reports closterospores regularly present. *F. singulare* is specialized on Bovidae as is also *F. album* of this group. *F. discoides* has an umbonate rather than an umbilicate disc, is probably adapted to the horse, and produces severe lesions in man. *F. abissinicum* may belong here or it may be an aberrant member of the *F. violaceum* group, but it was too poorly described to place definitely. The lesions and host would suggest relationship to *F. violacea*.

The principal group of species of *Favotrichophyton* shows a gradual degeneration from *F. balcaneum* in which there are traces of nodular organs through *F. flavivirens* to the yellow and ochraceous brown species and to the *F. violacea* group. The early members of this series, such as *F. balcanea*, are adapted to man or normal host unknown; the bulk of the yellow group to the Bovidae; the ochraceous group to the Equidae, and finally the *F. violaceum* group, producing endothrix lesions in the hair of man, with or without some suppuration, are not easily inoculable into the guinea pig. This group appears to be confined to the Semitic and related races. With this degeneration has come the production of moist colonies, often elaborately folded but of very circumscribed growth, as in the genus *Achorion*, whence the name "faviform" is often applied to the group. Descriptions of many of the species have been confined to the appearance of the colony on Sabouraud agar, so that new data may easily alter the arrangement adopted here.

Returning again to the main line of *Ectotrichophyton* at the stage reached in *E. felineum,* we find an easy transition to *Megatrichophyton.* This genus is very small and has lost all spore forms except chlamydospores and aleurospores. In *M. roseum* we find chlamydospores suggestive of very degenerate closterospores, in *M. caninum* these have disappeared although the chlamydospores are still well formed, while in *M. equinum* the latter are not numerous and are beginning to degenerate. The lesions seem to be confined to the follicles and epidermis, although a sheath of large spores is formed about the hair. There is no inflammation. *M. roseum* may also be found on animals, at least it is inoculable to guinea pig. *M. caninum* has been found only once on dog. *M. equinum,* normally adapted to and not uncommon on the horse, is inoculable to man and the guinea pig, producing only evanescent lesions in the latter.

For the main group of *Trichophyton* which still bears the name, let us return in the main line of *Ectotrichophyton* to the transitional species, *E. multicolor.* Nodular organs and spirals have disappeared. The transition to *Trichophyton flavum* is easy, although here the closterospore has disappeared. The species has not been found on domestic animals but is inoculable to the guinea pig. In this group (neoendothrix of Sabouraud), the juvenile condition of the lesion with the spores borne both without and within the hair persists for a long time.

The wholly endothrix species of *Trichophyton* form two groups: (1) those in which the crateriform type of colony is retained, where the hairs do not break quite so readily, and the basal portion is folded in the scale, (2) the more advanced group in which the colony has become umbonate and the hair breaks at the mouth of the follicle. There is some degeneration of chlamydospore and aleurospore traceable in this group. The end members no longer bear aleurospores in compound thyrses.

Returning to the main line in *Ectotrichophyton* we find *E. scorteum* as a transitional species to the *Microsporum* group, where the hair is invaded by mycelium and surrounded by a sheath of spores. In the *Neomicrosporum* group, the lesion has retained some of the suppurative character found in *Ectotrichophyton.* Usually the same organism is capable of attacking several host species. The closterospore is highly developed and characteristic. The chlamydospore is rare but functions as a cell of a closterospore, when present. Aleurospores are present and normal. In *Eumicrosporum,* the closterospore has become rare and reduced in number of cells until it is hardly more than a chlamydospore with a specialized shape but normal functions. Parasitism has become more specialized, until it is limited to prepubertal individuals in man and is very difficult to inoculate into any experimental animal. A still more specialized group is the subgenus *Kambayashia* in which some species have completely lost the closterospore and aleurospore. This subgenus seems confined to the yellow race of man as a host (see p. 545).

A somewhat similar line of degeneration may be traced in *Achorion. Achorion gypseum* (reported by Nannizzi to produce ascospores and consequently to belong in *Gymnoascus*) is very close to *Neomicrosporum* in the type of lesion produced (cf. Biltris 1929), but more suppurative, producing kerion of the glabrous skin with small but typical favic scutula. *Achorion muris, A. gallinae,* and *A. Schoenleini* retain some of their suppurative character when inoculated into another host from that on which they have become specialized. The first two retain closterospores, chlamydospores, and aleurospores of the *Neomicrosporum* group, while *A. Schoenleini* has lost all spore forms, but arthrospores and chlamydospores which function as closterospores.

Having considered the types of lesions and morphology of the group, let us return to the problem of classification briefly mentioned on page 434. Prior to the work of Sabouraud, some of the genera had been described, but little attention had been paid to them either by botanists or by medical men. As we have seen, Sabouraud separated his genera principally on the position of arthrospores in the lesion and his species on the presence of various spore forms and on the characters of the giant colony. On this basis, the name *Achorion* was used for all organisms causing favic scutula and typical favic hairs. *Microsporum* was used for all organisms producing a sheath of small arthrospores around the hair and mycelium within it. This was divided into the section *Neomicrosporum* for those which infect domestic animals, often with production of some suppuration. The species of this section grow much more rapidly in culture and become pleomorphic. The second section contains those species confined to man which grow slowly in culture and have no pleomorphism. *Epidermophyton* was used to designate the organism of eczema marginatum, the only organism of that group to be clearly recognized at that time. The residue was placed in *Trichophyton*, which was recognized to be somewhat heterogeneous. Sabouraud, however, separated this genus into several sections which make quite distinct groups and which were raised by Castellani & Chalmers to generic rank. The central group, which must retain the name *Trichophyton* according to the International Rules of Botanical Nomenclature, comprises the organisms producing arthrospores inside the hair, typified by *Trichophyton tonsurans (T. crateriforme).* The subsections were vaguely recognized without being named, the group of species centering around *T. tonsurans, T. Sabouraudi (T. acuminatum),* and *T. violaceum;* the groups were separated on the basis of giant colony characteristics and, somewhat, on morphology. A transitional group was made a separate section, Neoendothrix, centering around *T. flavum (T. cerebriforme),* in which the mycelium and spores persist in the hair follicle for a long time although the arthrospores are also produced in the hair as in *T. tonsurans.* Another section consisted of those species in which the arthrospores were borne outside the hair, forming a sheath somewhat resembling that of *Microsporum* but composed of both mycelium and arthrospores. This section, called Ectothrix, was divided into three subsections which differ rather more widely than the subsections of the Endothrix section. These were the faviform subsection, with a morphology and cultural characteristics close to *Achorion,* a megaspore subsection with large spores, and a microspore subsection called "microïde," comprising primarily the group producing kerions, which has been considered as the most primitive in the foregoing discussion.

Castellani & Chalmers (1919) followed the traditional procedure for large unwieldy genera and designated the Neoendothrix section as *Neotrichophyton,* the Ectothrix faviforme group as *Favotrichophyton,* and the rest of the Ectothrix group as *Ectotrichophyton,* dividing it into two subgenera as *Microtrichophyton* for the microïde subsection centering around *T. mentagrophytes (T. gypseum)* and the residue as *Euectotrichrophyton.* Finally, they placed in *Atrichophyton* a residue of several rather atypical species not included by Sabouraud.

In 1923, Ota and Langeron based a new classification on morphology as found in cultures on Sabouraud agar. They renamed *Achorion* as *Grubyella,* raised the *Trichophyton* ectothrix faviform group to generic rank as *Bodinia,* reserved *Trichophyton* for those species in which neither closterospores nor nodular organs were known, recognized *Epidermophyton* in its traditional sense as having only fusiform spores, and placed the residue of *Trichophyton* (mostly the microïde group) and *Microsporum* in a new genus called *Sabouraudites* (instead of *Microsporum* as required in the International Rules). They also violated the Rules in renaming *Achorion* as *Grubyella.*

The next year, ignoring the names proposed by Ota & Langeron, Grigorakis proposed *Aleurosporia* to replace *Trichophyton* as emended by Ota & Langeron; *Arthrosporia* to include *Endodermophyton, Bodinia,* and *Achorion; Spiralia* for the *T.* ectothrix microïde group which produce spirals; *Chlamydoaleurosporia* for species with chlamydospores and aleurospores, comprising *T. tonsurans* and the section *Aleurocloster* of Ota & Langeron. The residue was divided between *Closterosporia* and *Closteroaleurosporia. Closterosporia* included *Epidermophyton,* some of the animal *Neomicrosporums,* and *Achorion gypseum. Closteroaleurosporia* included human *Microsporum Audouini,* two *Achorions* from domestic animals, and *T. farinulentum* and *T. persicolor* of the microïde group.

In 1925, Vuillemin proposed that all species with closterospores be placed in *Fusoma,* ignoring the fact that in that genus there is very little mycelium and that if these species were to be placed in an already existing genus they could be more logically assigned to *Blastotrichum. Trichophyton* was placed in synonymy with *Aleurisma. Achorion, Endodermophyton* and the faviform group of *Trichophyton,* were placed with *Mycoderma* among the yeasts, in total disregard of their morphology.

In 1927 Guiart and Grigorakis attempted to simplify the confusion by recognizing *Microsporum* with two subgenera. The first of these, *Closterosporia,* included *Neomicrosporum* of Sabouraud, *Spiralia* of Grigorakis, and *Epidermophyton;* a second subgenus, *Closteroaleurosporia,* is identical with Grigorakis' former genus of that name. *Trichophyton,* comprising his *Chlamydoaleurosporia* and *Aleurosporia,* is essentially the same as Castellani & Chalmers' *Trichophyton* or Sabouraud's *Trichophyton* without the microïde and faviform group and *T. violaceum. Achorion* has been extended to include *Grubyella, Bodinia,* and *Endodermophyton,* his old genus *Arthrosporia.* Guiart and Grigorakis, however, foresee a probable splitting of their *Achorion* into its components.

In 1928, Ciferri tried to conflate the work of Ota & Langeron with the early classification of Grigorakis. He would recognize *Spiralia* of Grigorakis and

Aleuriosporia instead of *Trichophyton* as defined by Ota & Langeron. Also *Sabouraudites*, as Ota & Langeron characterized it, *Closteriosporia* in the sense of *Epidermophyton* (not as Grigorakis described it), *Grubyella* and *Bodinia* as Ota & Langeron characterized them, and finally *Arthrosporia* (in the sense of *Endodermophyton* Cast., not as Grigorakis used it). He also makes the error of typifying both *Spiralia* and *Sabouraudites* by *T. mentagrophytes* under the names *Spiralia asteroides* and *Sabouraudites asteroides*. His spelling is frequently incorrect. Bruhns & Alexander (1928) follow Sabouraud without change.

The latest attempt at revision is that of Langeron & Milochevitch (1930) who revived the use of complex carbohydrate media, such as starch, and found that several characteristic organs (e.g., spirals and nodular organs) were produced on these media in species which failed to produce them on Sabouraud's agar. They therefore take a very reactionary view and recognize *Epidermophyton*, and *Sabouraudites* of their former classification, and put all the rest in *Trichophyton*. They would abolish the subgenera they formerly erected in *Sabouraudites* and the distinctions of *Bodinia*, *Grubyella (Achorion)*, and *Endodermophyton*. They admit, however, that many organisms may not fit their present scheme.

From the above facts it is evident that many authors since Sabouraud have not followed the international rules of nomenclature in creating new names in their proposals. Some have not even typified their genera, so that the application of their names remains doubtful. After a careful consideration of the morphology of the fungus in both the lesion and the culture media, it would seem that in the present state of our knowledge the following groups are entitled to generic rank:

PRESENT CLASSIFICATION	TYPE SPECIES	SABOURAUD'S CLASSIFICATION	SYNONYMS
Trichophyton	*T. tonsurans*	*Trichophyton*	
Endothrix		Endothrix	
Malmstenia	*T. tonsurans*		
Sabouraudia	*T. Sabouraudi*		
Neoendothrix	*T. flavum*	Neoendothrix	*Neotrichophyton Cast.*
		Ectothrix	*Ectotrichophyton* Cast.
Megatrichophyton	*M. roseum*	Megaspores	*Euectotrichophyton*
Favotrichophyton		Faviformes	
Eufavotrichophyton	*F. ochraceum*		*Grubyella* p.p.
Bodinia	*F. violaceum*		*Bodinia* Ota & Lang
Ectotrichophyton	*E. mentagrophytes*	Microïdes	
	E. mentagrophytes	gypseums	*Spiralia* Grig.
	E. felineum	niveums	*Microtrichophyton* N.
Microsporum	*M. Audouini*	*Microsporum*	*Sabouraudites* Ota & Lang
Neomicrosporum	*M. canis*	*Neomicrosporum*	
Eumicrosporum	*M. Audouini*	*Eumicrosporum*	
Achorion	*A. Schoenleini*	*Achorion*	*Grubyella* Ota & Lang
Lophophyton	*A. gallinae*	*Neoachorion*	
Euachorion	*A. Schoenleini*	*Euachorion*	
Epidermophyton	*E. floccosum*	*Epidermophyton*	
Endodermophyton	*E. concentricum*		

The geographic distribution of these organisms is very interesting, although not so carefully studied as to allow us to make very satisfactory generalizations. Much suggestive data accumulated before 1928 have been summarized by Alexander & Bruhns, but so many records are based on a comparatively small number of cases or over such a short period of time, often in the presence of an epidemic which increases greatly the number of cases due to one organism, that the conclusions should be regarded as tentative. For example, cases of *Epidermophyton* infection seem to have been comparatively rare or at least rarely diagnosed and cultivated in Europe before the war and have not increased very notably since, while since the war in America it has been recognized in increasing frequency until it appears to attack very large percentages in certain portions of the population. Whether this should be considered an importation with the returned soldiers, or whether it represents increasing diagnostic skill among dermatologists and other physicians is difficult to state. A study of records of the Massachusetts General Hospital over the present century shows that diagnoses of mycoses of the glabrous skin have increased greatly, while eczema has diminished by about the same proportion. It would seem that there has been increased skill in recognizing the fungus nature of the disease rather than an actual increase in number of fungus infections. On the other hand, the general impression of several of the older dermatologists seems to be that *Epidermophyton* infections increased greatly after the war.

Data on the relation of infection by a given fungus to a given race are even less accurate, and much rarer. For example, the only cases of *Microsporum ferrugineum* infection are reported on Japanese and Chinese, but I know of no inoculation experiments with this fungus on members of other races. Again, *Favotrichophyton violaceum* seems confined to the Semitic race or to populations where there has been a large admixture of Semitic blood, but there are very few statistics to prove this point and I know of no inoculation work. In Algeria and Tunis it is confined to the Arab population and Italian immigrants. In the former Russian Empire it appears in surveys only in regions with large Jewish populations. It also occurs quite frequently in Italy, especially in the southern part. Here I know of no statistics in which racial characteristics are recorded, but it should be remembered that this region has been invaded several times by Semitic peoples. Similarly, it is more common in the cities of southern France than farther north. In the United States our experience indicates that it is largely confined to persons of Russian-Jewish extraction. It occurs occasionally in Brazil, Uruguay, and Argentina, in some cases being mentioned as occurring only on Jews. The closely related species, *F. glabrum* (Catanei 1929, 1930, 1931, 1933), has approximately the same distribution, but is usually rarer. In Algeria most of the statistics show that in the indigenous population *F. glabrum* is slightly more common, while in the Jewish population *F. violaceum* is the more common. The percentage of tinea and favus cases is much larger among the native population.

The changes in the dermatophyte flora of Europe since the war have been remarked by several investigators. Several species, such as *Microsporum*

Audouini, Ectotrichophyton granulosum, Megatrichophyton roseum, etc., which before the war were confined to France and in some instances parts of the Rhine valley, have now become fairly common and endemic in Germany, and in some cases also in portions of the old Austro-Hungarian Empire. Epstein (1931) presents interesting statistics of the flora in Breslau 1918-1921 and 1927-1929. *Ectotrichophyton mentagrophytes, E. granulosum, Trichophyton flavum,* and *T. cerebriforme* showed big decreases, *E. mentagrophytes* var. *radiolatum,* other species of the *Trichophyton flavum* group, *Megatrichophyton roseum, Favotrichophyton violaceum,* and species of *Epidermophyton* and *Achorion* show large increases.

Besides the local floras of Algeria by Catanei mentioned above, several detailed ones have been prepared by various authors in Hungary and in Germany. The German accounts probably do not present an accurate picture of the normal endemic flora since several include periods in which there was an epidemic, causing the relative numbers of some one species to be greatly exaggerated. Thus, a subsequent author may present a very different picture. Berde (1930) presents interesting data on local distribution in various portions of Hungary. In America we have only occasional lists, mostly from Brazil, Uruguay, and Argentina. It is suggestive to note that the flora of Montreal on the edge of French Canada contains several species which are otherwise unknown outside of France. Similarly in Boston, most of the cases, except those due to the genus *Epidermophyton,* occur on immigrants or children of immigrants. In South America, *Microsporum felineum* is apparently the commonest species reported, but since *M. fulvum* is not mentioned, one cannot help wondering if these cases should not be referred rather to *M. fulvum.* From the published data, there is little opportunity to correlate the organisms named with a possible source since I know of no extensive statistics of the Iberian Peninsula. Catanei remarks that he found no tinea on children of Spanish descent. Martins de Castro excludes all foreigners from his statistics of São Paulo, but, aside from the huge preponderance of *M. felineum,* his statistics resemble those of Europe to such an extent that one wonders if most of the species may not have been introduced during the immigration of the last century.

Another factor which should be considered is that in the above-mentioned countries of America, the immigrant has a lower economic status and consequently is often poorly nourished and more susceptible to these diseases. On the other hand, to the *Epidermophyton* group, which attacks the vigorous and well nourished, the native Americans of the white race seem as susceptible as the immigrants.

Physiology.—The first extensive paper dealing with the physiology of these organisms was that of Verujsky (1887) who made a comparative study of the physiology of *Trichophyton tonsurans* and *Achorion Schoenleini,* finding a neutral or slightly acid medium and a temperature of about 33° C. the best for growth. Biltris (1929) emphasizes the influence of small changes in pH on the appearance of the giant colony in *Achorion gypseum.* Vamos (1932) found that *Microsporum Audouini* and *Epidermophyton floccosum* (*E. inguinale*) have an optimum hydrogen ion concentration of 6.5 to 7.2, while *Achorion* and *Megatrichophyton roseum* (*Trichophyton rosaceum*), *Favotrichophyton violaceum* (*T. violaceum*), and *Ectotrichophyton mentagrophytes* have a much wider range. That author used this fact to explain that the former species are practically confined to prepubertal individuals in which the hairy areas have a pH of 6.2-6.5, and disappear after puberty, when the pH of these areas has increased to 4:5-5.6.

Scolari (1931), working with *Achorion Schoenleini, Microsporum Audouini,* and *Favotrichophyton violaceum*, found differences in growth rates on media of different pH, but found practically no alterations in colonies nor in spore forms, other than the disappearance of spores near the limits of growth.

Further work on temperature has developed partly in connection with observations in laboratory cultures where it has been noted that the color at 37° C. may be altogether different, although equally characteristic, from that at room temperature (about 20° C.). In the systematic discussion in this work, colors are to be assumed at the room temperature common at the place cultivated unless otherwise specified. This temperature may be as low as 15° C. in many of the European laboratories, about 20° C. in American, and somewhat higher in the tropical ones (about 25-30° C.). Skin temperature is usually somewhat less than body temperature, a fact frequently overlooked in dealing with skin parasites (Kadisch 1933). This is especially true for the group under consideration, which does not penetrate beyond the horny layer. Therefore, while room temperature is undoubtedly too low to reproduce conditions under which they grow on the host, 37° C. is several degrees too high. For example, Jadassohn & Stahelin (1930) have shown that when inoculated guinea pigs are kept in a ventilated incubator at 36-39° C. and show a rectal temperature of 39-41°, about double the time was necessary to develop lesions in the case of *Ectotrichophyton mentagrophytes* (*T. gypseum*) and *Achorion muris* (*A. Quinckeanum*).

Similarly Kadisch (1933) has shown that guinea pigs inoculated with *Achorion gypseum* at Davos, Switzerland, 1,600 m. where the air temperature was lower and the oxygen pressure less than the controls inoculated in Berlin, developed superficial lesions much more slowly, and the lesions healed much more rapidly than the controls. In vitro experiments also pointed to an optimum temperature for this organism intermediate between room temperature and 37° C., and showed that any reduction of oxygen pressure near the optimum temperature greatly checked growth. Folding of colonies is greater near the optimum temperature and is taken as a need for exposure of a larger area to the air during rapid growth. Perhaps these facts explain why most of the ringworm infections occur at lower elevations and in the warmer regions of the earth.

In most cases it appears to make little difference whether the colony develops in light or darkness. Peña Chavarría & Clark (1924) found the following durations of exposure to ultraviolet light at 30 cm. from the arc necessary to kill: *Trichophyton tonsurans* (*T. crateriforme*) 2 min., *Microsporum fulvum* 2 min., *Achorion gallinae* 4 min., *Ectotrichophyton granulosum* 6 min., and *T. Sabouraudi* (*T. acuminatum*) 18 min. Roentgen rays had no effect. One drop of a 0.1% aqueous solution of eosin applied to the point of inoculation on nonpigmented skin sensitizes it to visible light. They found that lesions on guinea pigs infected with *T. Sabouraudi* cleared up promptly when treated daily with eosin, while controls, both untreated and treated, kept in the dark, did not improve. Scott & McKinley (1930) working with *Ectotrichophyton mentagrophytes* (*T. asteroides*) found 30 cm. from an "Alpine sun lamp" for 5 min. fatal to the fungus in 2 c.c. of saline solution in quartz tubes. Miescher (1925), working with *Ectotrichophyton mentagrophytes* (*Trichophyton gypseum*) found that 1 mg. radium at 4-8 cm. distance did not influence germination. He also found that 24.9 mg. radium filtered through 0.1 mm. silver filter at 3-10 cm. distance did not influence growth of a 5-week-old culture. The same amount of radium at 15 mm. distance began to slow up growth after 8 days and stopped it after 14 days. No growth stimulation was noted.

Verujsky (1887) reported that spores of *T. tonsurans* were killed by heating in distilled water to 49° C. for 10 min., while *Achorion* spores germinated after such treatment.

Verujsky (1887) also reported that *Achorion* does not utilize sugar while *Trichophyton tonsurans* utilizes it, forming oxalic acid as an intermediate product. Saccharose is not inverted. On malt medium the weight of mycelium is about half the weight of sugar consumed by it; if glycerol is added to the medium this ratio is 2:3. Both organisms liquefy gelatin rapidly. Macfayden (1894) confirmed this for gelatin and found no action of milk or fibrin; *T. tonsurans* grew on keratin, but he was unable to demonstrate an enzyme attacking it. Roberts (1899) found protease in cultures 6 years old. Bodin (1899, 1901) worked on *Microsporum equinum* but, as he mentions an *Oospora* form which was probably a contaminant, it is difficult to know which action was due to which organism. In 1902 he found that *Achorion muris* utilizes glucose more readily than lactose or maltose and that casease, rennin, and gelatinase are excreted to the culture medium.

In 1907 he described trypsin, gelatinase, rennin, and casease in *Achorion gypseum.* In 1922 Greenbaum reported liquefaction of gelatin in 24 hours by *Ectotrichophyton mentagrophytes, E. granulosum, E. lacticolor,* and *E. felineum, Megatrichophyton vinosum, Trichophyton tonsurans* (*T. crateriforme*), *T. Sabouraudi* (*T. acuminatum*), *T. sulfureum, T. exsiccatum, T. fumatum, T. flavum, T. plicatile, Favotrichophyton violaceum, Microsporum pubescens, M. canis* and *Achorion muris,* very slow liquefaction by *Megatrichophyton roseum, Microsporum fulvum, M. Audouini, Achorion Schoenleini,* and *A. gallinae.* He reports no fermentation of sugars and no indol production. Mallinckrodt-Haupt (1928) reports trypsin in *Ectotrichophyton mentagrophytes, Megatrichophyton roseum, Favotrichophyton violaceum, Achorion muris,* and *A. Schoenleini.* Hopkins and Iwamoto 1923, using 99 strains and 17 carbohydrates, found acid production from d-mannite, mannose, d-glucose, and d-fructose, none in lactose, sucrose, xylose, or l-arabinose. He lists as slowly fermenting *Epidermophyton floccosum, Favotrichophyton violaceum, F. album, F. ochraceum, Megatrichophyton roseum,* and *M. vinosum;* as intermediate, *Microsporum Audouini,* all species of *Trichophyton* tried; and as rapid fermenters, *Microsporum Neomicrosporum* group (*M. canis, M. fulvum etc.*) ; *Ectotrichophyton, Epidermophyton rubrum, E. interdigitale, Achorion Neoachorion* group (*A. gallinae* and *A. muris*). He gives tables showing differences of the individual sugars.

Mallinckrodt-Haupt (1927) found that *Ectotrichophyton mentagrophytes, Achorion Schoenleini, A. muris,* and *Megatrichophyton rosaceum,* were able to split fats (using tributyrin) and utilize both glycerol and fatty acid, hence probably human oil is no deterrent to these fungi. The individual strains showed considerable variability.

Finally Tate (1929) has made the fullest study of enzymes in the group, working with *Microsporum canis, Ectotrichophyton mentagrophytes* var. *radiolatum* both normal and pleomorphic mycelia, *Microsporum Audouini, Trichophyton tonsurans,* and *Achorion Schoenleini.* He found peroxidase, catalase, trypsin, pepsin, lipase, maltase, amygdalase, and amylase in all species tried; no keratolase, invertase, inulase, lactase, or zymase in any species; urease was absent in *T. tonsurans,* a small amount was present in normal mycelium of *E. mentagrophytes* var. *radiolatum,* and much in the pleomorphic mycelium of that species. He found that in general the amount of carbohydrase present was inversely proportional to the protease present. Besides studying enzymes, he notes that these species can utilize nitrates and ammonium salts as sources of nitrogen, but they cannot utilize sodium acetate, formate, or lactate as sources of carbon. The possible limits of growth were not determined, but it was possible at least from pH 3 to pH 8 with an optimum of pH 6-7. The maximum concentration of phosphates in buffered solution was about M/60.

Goddard (1934) working with *Epidermophyton interdigitale* and *Microsporum canis* (*M. lanosum*) found that glucose, mannose, fructose, arabinose, and to some extent sucrose increased growth, galactose was used by *E. interdigitale* only, and lactose was not used. Glucose decreases the rate of protein hydrolysis but not the formation of ammonia from amino acids with the consequent decrease of hydrogen ion concentration of the medium. Casein and peptone support growth and are hydrolyzed to polypeptides, amino acids, and finally ammonia. In glucose peptone cultures, the curve of growth, the curve of ammonia nitrogen production, and the curve of glucose consumption are similar in shape during the period of exponential growth (9-21 days).

Pigments of *Megatrichophyton roseum, M. vinosum, T. Sabouraudi, Ectotrichophyton mentagrophytes* var. *radiolatum,* and *Epidermophyton rubrum* were isolated. They were red to reddish brown, easily soluble in dilute acids and acid alcohol but only very slightly in dilute alkalis. The color is yellow in acid solution and red or reddish brown in alkaline solution. They are not destroyed by boiling, and the acid solutions pass readily into ether and chloroform. Alkaline solutions reduce to a clear yellow solution with sodium thiosulphate and reoxidize to red in contact with air. These are probably anthracene pigments related to those of the Caloplacaceae and Teloschistaceae among the lichens.

The viability of *Ectotrichophyton mentagrophytes* in straw, wood, horn, and similar substances was studied by Brocq-Rousseu, Urbain & Barotte (1928), and by Urbain (1929). In such situations, the organism retained its virulence for at least nine months and in pure culture, at least 2 years.

Kadisch (1929) made a similar study with *Achorion gypseum, Epidermophyton interdigitale, E. floccosum, Ectotrichophyton granulosum,* and *E. mentagrophytes* var. *radiolatum, Trichophyton flavum,* and *Achorion muris* on silk, wool, leather, and feathers and found that the organism survived on these substances; hence clothing of these materials might be capable of transmitting the disease. That these organisms may not only survive but also multiply rapidly on these materials is probable from the amusing case, reported by White, of a wealthy woman of Boston who felt that she could not intrust her silk underwear to anyone but her special laundress. On a pleasure trip to Bermuda she accumulated her laundry for several weeks and on her return home had it done in proper style by her own laundress. The next week she appeared with a generalized infection of *Epidermophyton* covering practically the whole area which had come into contact with her underwear. Apparently her quiescent *Epidermophyton interdigitale* had developed from scales in her silk stockings and spread to all the rest of the underwear during the warm, moist conditions of the voyage. It would seem that a return to cotton underwear which can be easily sterilized would decrease the spread of these infections, although Kadisch (1931) reports that silks may be disinfected from *Achorion gypseum* by exposure to thymol vapor for one week or to 70% alcohol without injury to the fiber. Bonar & Dreyer (1932) continued this line of investigation using *Epidermophyton interdigitale, E. floccosum, Microsporum canis* (*M. lanosum*), and *Megatrichophyton roseum* (*T. rosaceum*). They found that the organism does not grow on sound, clean wood, but that it grows readily on floor material that is covered by a coating of slime or algal growth. Zinc chloride, sodium hypochlorite, and copper sulphate in 1% solutions were found insufficient to sterilize completely floor materials coated with slime on which the fungus was growing. Exposures up to an hour in sodium hypochlorite solution were necessary to disinfect scales, although 10 minutes showed a decrease in the number of positive cultures from treated scales. Temperature studies showed complete disinfection of clothing materials in 10 minutes at 75° C. Correlating with standard laundry practice shows that white cotton fabrics will be returned from the laundry free of dermatophytes, while sterilization of woolens or silks is doubtful. The standard dry cleaning solvents have a negligible killing action in exposures of one to two hours. Mendel (1932) has proposed the disinfection of shoes and other leather goods by formaldehyde. Lomholt (1932) suggests rinsing woolen socks in denatured alcohol, then wrapping them in brown paper for two days before rinsing in water and drying.

Catanei (1932) has shown that following ingestion of spores of *Ectotrichophyton mentagrophytes* by the guinea pig, typical lesions are produced on the scarified back in approximately the same time taken for the lesion to result from direct inoculation on the scarified back. Dhayagude (1931) fails to confirm the work of Brocq-Rousseu, and Urbain & Barotte (1926), finding no pathogenicity on intravenous and intraperitoneal injections.

The oxygen requirement of these organisms has been little studied. Kadisch (1930, 1933) found that growth was always superficial, never in mucous membranes and found that with *Achorion gypseum* there was slower growth at lower oxygen pressure. Intraperitoneal injection in the frog showed growth of the organism in the lungs, not in other organs. Following up this idea in 1931, Kadisch & Loewy reported that with increasing altitude, the period of incubation lengthened from 4 to 10 days, the lesions were smaller, there was less infiltration and scaling and that the hyphae were less abundant in the lesions, apparently due to lowered oxygen pressure. Kadisch (1929) has also studied the question of subcutaneous and intracardial inoculations of *Achorion gypseum.* In the guinea pig, no growth was found on the internal organs in vivo, but growth occurred when they were removed and incubated at temperatures below normal body temperature. He found best growth at 27° C. Similar conditions prevailed in the frog, the organism surviving a long time in the internal organs. Similarly Jadassohn (1927) showed that with *Achorion muris,* in one to one and a half hours after cutaneous infection, the organism could be found in the blood and would produce skin lesions in sandpapered areas. In 1928, he showed that *A. muris* grows readily on excised guinea pig organs, although it does not produce lesions in vivo. *Microsporum Audouini* and *Ectotrichophyton mentagrophytes* grow on sterile skin taken from the body under sterile conditions. In 1931, Jadassohn and Rehsteiner attempted inoculations in the eye, using *A. muris, A. Schoenleini, Microsporum Audouini,* and *Ectotrichophyton mentagrophytes,* but found no growth except in the lens with *Achorion Schoenleini* and *E. mentagrophytes.* Toma (1929) secured infection of hairs in vitro by moistening them with a dilute solution of sugar and peptone in serum.

Fabiani (1932) reports that *Achorion Schoenleini* will not grow in media which has grown *Staphylococcus* and will grow well on the antivirus of the same strain (originally isolated from the same lesion as the *Achorion*).

McNealy & Lichtenstein (1929) call attention to frequent flare-ups of chronic ringworm conditions following trauma.

Therapeusis.—No attempt will be made to cover this phase at all fully. The botanist who may wish to know something of the preparations commonly used in dermatology, will find much useful information in Abramowitz' excellent formulary (1931). Papers dealing with this phase may be divided into two groups: those resulting from dermatologic practice with experimentation on human lesions in vivo, and those resulting from surveys of various groups of toxic substances on a variable number of organisms in laboratory culture with conditions variously controlled. Unfortunately the latter type of experimentation, which is more logical, has not yielded much information useful in practice, as often these organisms behave very differently in the human skin from the way they do in culture.

Owing to the difficulty of securing penetration into the horny layer of the skin, hair follicle or hair, most of the usual antiseptics are useless. By use of a keratolytic, such as salicylic acid or chrysarobin, the horny layer may be peeled off faster than the fungus penetrates the newly formed layer. This is essentially the action of such ointments as Whitfield's,* with its numerous modifications, of which Swartz'† seems to give very good results in cases which I have followed personally.

Iodine was extensively used formerly, but its use is subject to the usual disadvantages. Castellani‡ (1928 and frequently reprinted) reports good results with carbolfuchsin paint. Cattaneo (1923) reports success in sycosis following intravenous injection of iodine solutions. Swartz et al. (1930), and Blumgart et al. (1931) report favorably on the inhalation of ethyl iodide. Lieberthal (1928) reports success with mercurochrome in *Microsporum* infection in the scalp. In epidermophytosis, Matta (1928) suggests the use of oleo de andiroba or the oleoresin of tamaquare (*Caraipa silvatica* B. Rodr.) in various formulae. Probably these function as keratolytics. Navarro-Martin (1932) reports healing of kerions following intravenous injections of trypaflavine.

Kingery & Adkisson (1928) tried many volatile oils on 20 strains of skin pathogens and found aqueous solutions of thymol, cinnamon oil, and eugenol (clove oil) superior to others in the order named, for restraining growth on agar; and Kingery (1929) reported on the use of thymol and cinnamon oil in the treatment of ringworm of the scalp. Gould & Carter (1930) studied the toxicity of mixtures of benzoic and salicylic acids (the important constituents of Whitfield's ointment) in vitro to *Epidermophyton pedis* (*Trichophyton pedis*), *E. purpureum*, and *E. interdigitale*, and reports that salicylic acid 1:30,000 + 1:2,250 benzoic acid restrained most cultures. In 1932, they reported that liquor hexyl resorcinolis 1:1,000 (ST. 37) was equivalent to salicylic acid 1:30,000, while mercurochrome 220 soluble showed no fungistasis at 1:600 for 3 strains of *Epidermophyton interdigitalis, E. pedis* and 2 strains of *E. purpureum*. Schamberg, Brown & Harkins (1931) report that iodine 1:85,000 kills in 15 minutes; mercury acetate and crystal violet 1:20,000 in 25% alcohol and acetone solution and mercury acetate and fuchsin are also good. They suggest the following ointment: oil of cloves 0.06 c.c., oil of cinnamon 0.06 c.c., iodine 0.03 gm., white petrolatum q.s. 30 c.c. (zinc oxide may be added if desired).

Strickler (1933) after further studies of fungicides developed the following formula: iodine crystals 1.3 gm., potassium iodide 1.9 gm., salicylic acid 1.9 gm., boric acid 3.8 gm., and alcohol 50% to make 59.1 c.c. Zifferblatt and Seelaus (1933) have studied the action of iodine vapor on the skin and on various fungi. Fernet & Boyer (1933) advocate tincture of iodine 10% and 90%-alcohol 90%, or quinosol 1 gr., 80% alcohol 40 gm., glycerol 20 gm., and water 120 gm. Legge, Bonar and Templeton (1934) after trying a large number of substances upon many students concluded that equal parts tincture of iodine and glycerol was the most satisfactory, and plan further experiments with related formulae. They also report that the addition of 1.4% thymol to Whitfield's ointment improved its usefulness, although thymol alone was not especially promising. Li Hsueh Yi (1933) reported a series of in vitro tests in which he found thymol, Castellani's fuchsin paint, benzoic acid, and salicylic acid quite toxic, resorcin and hexylresorcinol were toxic in higher concentrations only, while saturated carbolfuchsin, 50% alcohol, sodium thiosulphate, and mercurochrome 220 (5%) were nontoxic to the species used.

---

*Whitfield's ointment: salicylic acid 2 parts, benzoic acid 4 parts, ointment base 30 parts.

†Swartz' ointment: salicylic acid 2 gm., mercurochrome cryst. 0.68 gm., hydrous wool fat 16 gm., petrolatum 16 gm.

‡Castellani's carbolfuchsin paint: 10 c.c. saturated solution of basic fuchsin; 100 c.c. 5% phenol in aqueous solution. Filter, add 1 gm. boric acid, and after 2 hours add 5 c.c. acetone. After 2 more hours add 10 gm. resorcinol. Keep in the dark.

Miyake (1925), in a study of vital staining by means of Sabouraud agar to which the dye has been added, found that growth was not affected by eosin, phloxine, alkali blue, and benzopurpurine, while it was inhibited by Nile blue, neutral red, and methylene blue. He used *Ectotrichophyton mentagrophytes, Favotrichophyton violaceum, Microsporum japonicum,* and *Epidermophyton floccosum. Ectotrichophyton mentagrophytes* contains a phenolase. Thionin changed color near the colonies. Leonian (1932) studied the action of malachite green and crystal violet on 26 species. He points out the need for care in such studies in securing a uniform inoculum. His emphasis on the position of inoculum seems unnecessary. Apparently the failure of the organisms to grow when the inoculum was upside down is due to low oxygen tension rather than to any geotropic stimulus, or acclimatization of the fungus to the toxic medium.

The problem of therapeusis in the follicle and hair is much more difficult as it is practically impossible to secure the penetration of any antiseptic. The actively suppurating lesions will heal spontaneously by expulsion of the infected hair along with the pus and subsequent cicatrization, usually allowing a new hair to grow. The oldest method of treatment is manual epilation which is very slow and unless it is very thorough, gives large chances of reinfection. The roentgen ray epilation has the advantage of completeness but must be applied very exactly, as a very slight overdose may prevent new hair growing again. Irritating substances may also cause depilation but should be applied cautiously under adequate medical supervision. Neidhart (1924) reports killing spores by x-rays and radium. Recently thallium acetate has enjoyed popularity, but it is extremely toxic and great suffering has been caused by its careless use, not only through a total and permanent loss of hair, including all body hair, but also through arthritis and other ailments. Some of the proprietary depilatory creams, etc., have been found to contain this substance and should be avoided except under a physician's advice.

Since the discovery that the infected hair is extremely greenish fluorescent in ultraviolet light, while normal hair does not fluoresce, many dermatologists are returning to manual epilation. A deep violet nickel oxide glass is used to screen out the visible spectrum while transmitting 70-80% of the ultraviolet light. This lamp is currently known among dermatologists as a Wood light. (Roxburgh 1927, Hill 1928.)

Mallinckrodt-Haupt & Carrié (1934) have attempted further study of the fluorescent substance. The fungi growing on the usual media do not show fluorescence, but do fluoresce when grown on Fink's medium consisting of 1,000 c.c. water, 100 gm. sucrose, 1 gm. urea, 0.5 gm. calcium chloride, 0.4 gm. magnesium sulphate, 0.75 gm. monopotassium phosphate, 0.25 gm. disodium phosphate, and 0.14 gm. calcium carbonate. *Achorion Schoenleini* fluoresces greenish, gradually changing to copper-blue in age, *Microsporum Audouini* greenish yellow changing to yellowish green, *Ectotrichophyton mentagrophytes* (*Trichophyton gypseum asteroides*) greenish blue changing to blue, *Epidermophyton floccosum* (*E. inguinale*) slightly green, and *Sporotrichum Schencki* (*S. Beurmanni*) green changing to blue. They were unable to extract the fluorescent substance by any of the usual solvents, but the substance diffuses out of the mycelium on treatment with either acids or alkalis. Apparently the substance is localized in the cell walls of the hyphae but is not found in spores. They were unable to purify the substance completely.

Davidson and Gregory (1933) emphasize the desirability of examining pet animals suspected of ringworm as well as patients, citing the case of a child with extensive lesions due to *Microsporum felineum* contracted from a kitten which failed to show the disease at the ordinary clinical examination, but revealed a few scattered infected hairs on the face and about one ear upon examination in ultraviolet light.

Immunology and Related Phenomena.—This subject has been thoroughly reviewed by Bloch (1928 a) and will not be considered in detail here, as it is largely beyond the province of this work. Bloch summarizes the work mostly done on *Achorion* (subgenus *Neoachorion*), *Ectotrichophyton* and to a slight extent on *Microsporum* (subgenus *Neomicrosporum*), and *Favotrichophyton.*

If the skin of man or other experimental animal is inoculated with a pathogenic dermatophyte, either cutaneously or by way of the blood stream, the fungus grows only in the horny layer of the skin. The metabolic products, developing primarily at the site of inoculation, but also in other organs, especially throughout the skin, determine the fate of the fungus; the nature, duration, and healing of the lesion; and the subsequent reaction (after complete healing of the primary lesion) to a reinoculation or to an application of the toxin produced by the fungus (trichophytin). This change in the constitution (especially of the skin) is allergic. The degree of allergy (reaction to reinoculation) is dependent on the species and virulence of the particular strain of the fungus, the duration, depth, and number of the primary lesions (especially in man), the number of inoculations (increase of allergy with number); the choice of experimental animal, perhaps also the region of the skin, and the time and site of the reinoculation (allergy begins when antibodies are first formed as the primary lesion has reached its crisis and begins to heal; it decreases with distance from the site of the primary lesion). The allergy seems to be a group reaction to the dermatophytes rather than specific for each species (cf. Talice & MacKinnon 1931). Precipitins, agglutinins, and complement fixing antibodies are also produced (Greenbaum 1924); also an antibody which greatly checks the growth of the fungus and which may be important in the healing process. These substances affect the severity and duration of successive reinoculations but not the kind of lesion.

The fact that these organisms multiply and produce lesions only in the horny layer of the skin while they are able to survive in the internal organs and to travel in the blood stream seems to show that the horny layer (as dead tissue) furnishes the only suitable substrate. The susceptibility of man and other animals to certain species probably is related to chemical changes in the composition of this layer or to structural changes in this layer (puberty effect, cf. work of Vamos 1932 showing changes of hydrogen ion concentration of sweat, etc., also Louste, Rabut, & Rivalier, 1933). Also it may be noted that the skin of the living guinea pig, which is not infected under ordinary conditions, when removed from the animal furnishes a good substrate for the cultivation of *Microsporum Audouini.* The variability of virulence and natural immunity has often been noted. A successive passage through experimental animals may either increase or diminish virulence. Species which are largely or entirely confined to a single host, or even the usual host of species which infect a variety of hosts, produce little inflammation and little allergy although they are more contagious and of longer duration.

The particular clinical and histologic form in which the presence of the fungus is manifest seems to be the result of allergic phenomena. This would account for kerion and sycosis being produced by such a variety of species while favus, tinea tonsurans, and tinea microsporica are largely confined to one species each. The same species can produce different types of lesions on different regions of the skin. Allergy would also explain the frequency of lesions in which no fungus can be isolated but which resemble the fungus lesions very closely. (For further clinical discussion see Scholtz, 1932.) Bloch (1928 b) has also given a very extensive résumé of this literature to date. These lesions, which are produced by substances transmitted by the blood stream to some distance from the primary lesion, are called trichophytides, microsporides, epidermophytides, and favides, depending on the genus of the fungus causing the primary lesion. Curiously, they seem to be largely confined to the prepubertal males, about 90% of the recorded cases being reported on children and 75% on males. In most cases the primary lesion is not the milder type caused by fungi restricted to man, unless the latter are unusually virulent and produce some inflammation. Usually general symptoms occur, such as headache, loss of appetite, fever, and swelling of the lymphatics in the vicinity of the primary lesion. The blood shows increased leucocytes, especially polynuclears to about 14,500, and some increase in lymphocytes. The generalized symptoms are usually of short duration. The skin lesions may be lichenoid (lichen trichophyticus), maculopapulose and polymorph exudative, scarlatinoid, or similar to erythema nodosum (subcutaneous nodules). Recently Jauison and coworkers (1932) have presented the view that lichen planus and perhaps psoriasis may be essentially allergic phenomena following a chronic ringworm infection, as all cases of lichen planus and 80% of the psoriatics examined reacted with an intradermal injection of a polyvalent dermatophyte serum.

Key to Genera

- Closterospores incompletely 4-6-locular, coenocytic, germinating either by a single hypha from each locule or each locule forming a single, uninucleate endospore; on glabrous skin of old world monkeys, inoculable into guinea pig forming ectoendothrix lesions. *Pinoyella.*
- Closterospores completely septate; colony velvety.
  - Either spirals or nodular organs present on some media and well developed; lesions of the ectothrix type, hyphae not seen in the hair. *Ectotrichophyton.*
  - Neither spirals nor nodular organs present.
    - Closterospores thin-walled with blunt ends, aleurospores rare or absent in most species; chlamydospores rare; lesions of the glabrous skin and nails, not attacking the hair. *Epidermophyton.*
    - Closterospores thick-walled with pointed ends, aleurospores present and well developed; hair invaded by hyphae.
      - Hyphae not disappearing from the hair but producing a sheath of small spores at the surface. *Microsporum.*
      - Hyphae disappearing from the hair, their place showing in microscopic preparations as air bubbles, favic scutula in the hair follicle common and characteristic. *Achorion* sect. *Lophophyton.*
- Closterospores absent, chlamydospores usually abundant.
  - Aleurospores abundant and characteristic.
    - Colony velvety, arthrospores not conspicuous and characteristic.
      - Lesions of ectothrix type with large spores, producing sycosis in man and dry squamous lesions in domestic animals. *Megatrichophyton.*
      - Lesions of endothrix type, without inflammation or suppuration, common on man, rare on domestic animals. *Trichophyton.*
    - Colony moist, arthrospores present; lesions of endothrix type.
      - Lesions with suppuration in domestic animals but inoculable into man. *Favotrichophyton* sect. *Eufavotrichophyton.*
      - Lesions with some inflammation in man, not easily inoculable into domestic animals. *Favotrichophyton* sect. *Bodinia.*
  - Arthrospores common and characteristic, aleurospores rare or absent, no suppuration on the usual host.
    - Colony velvety, lesions of the glabrous skin of man, inoculable with difficulty into experimental animals. *Endodermophyton.*
    - Colony moist, yeastlike; lesions of the hair with favic scutula in man. *Achorion* sect. *Euachorion.*

PINOYELLA

Pinoyella Castellani & Chalmers, Man. Trop. Med. ed. 3, 1023, 1919.

The type species is *Pinoyella simii* Castellani & Chalmers.

Mycelium dimorphic, closterospores incompletely 4-6-locular, coenocytic, germinating either by a hypha from each locule, or by the formation of a separate endospore in each locule. The endospore is ejected from the end of the closterospore and is uninucleate, giving rise to a uninucleate secondary mycelium which bears uninucleate aleurospores.

The phylogenetic position of this genus is not altogether clear but it would seem to be primitive, the incompletely divided closterospore representing a gametangium of the general type of that of the Ascoideaceae where the spore number is reduced (or the spore may even germinate before forming its wall). The resulting mycelium would be homologous with uninucleate diploid ascogenous hyphae and the aleurospores with asci. On the other hand, although less probable, the closterospore may represent an ascus and the aleurospore uninucleate haploid conidia.

The genus may be differentiated from other members of the group by the incomplete division of the closterospore with the formation of endospores.

Pinoyella simii Castellani & Chalmers, Man. Trop. Med. ed. 3, 1023, 1919.

Epidermophyton simii Pinoy, C. R. Soc. Biol. **72**: 59, 1912; Bull. Soc. Path. Exot. **5**: 60-93, *Pls. 3, 4,* 1912.

A transmissible disease of the glabrous skin of monkeys first described by Levaditi and shown to be mycotic by Ravaut. Inoculable to guinea pig, producing swelling of skin and some invasion of the hair of the ectoendothrix type. In epidermis the mycelium is composed of short cylindric cells, 4 × 5.8μ, easily dissociated. Closterospore 4-6-locular, rarely less, the septa not complete, so it is in reality only a coenocyte with constrictions, germinating with as many filaments as locules. The contents of each locule may be isolated by a wall as thick as the wall of the closterospore, thus forming spores which are expelled from the upper end of the closterospore, if it is still attached to the mycelium, or by either end if it is free. Each of these endospores is uninucleate, contains reserve food granules, and germinates either with septate, uninucleate secondary mycelium or directly to a sporiferous hypha of the *Acladium* type, producing uninucleate lateral aleurospores 2.5-3μ. No spirals or nodular organs are present.

On Sabouraud medium, it forms an orange yellow point on the fifth or sixth day, producing thick-walled closterospores. Growth slow at first, subcultures of more rapid growth, forming a white velvety mycelium with very degenerate closterospores as in subcultures of *Microsporum canis.*

EPIDERMOPHYTON

Epidermophyton Sabouraud, Les Maladies du Cuir Chevelu **3**: 420-446, 1910, not *Epidermidophyton* Lang, Klin. Vorträge 7 ser. **208**: 1765-1788, *8 figs.*, 1879, nor *Epidermophyton* Mégnin, C. R. Soc. Biol. **33**: 404-406, 1881, nor Guéguen, Champ. Paras. Homme Anim. **145**: 1904.

While Lang proposed the name *Epidermidophyton* in 1879, it was not proposed as a genus name but rather as a common name for fungus filaments seen in the scales from a psoriatic lesion. So far as I have been able to ascertain, Sabouraud was the first to use *Epidermophyton* as a generic name in its present sense.

The type species is *Epidermophyton inguinale* Sabouraud or *E. floccosum* (Harz) Langeron & Milochevitch.

Growing only in the horny layer of the epidermis, not attacking hair follicle or hair, closterospores common and conspicuous in most species, chlamydospores less abundant and conspicuous, aleurospores rarely present. Only one species has been carefully studied morphologically and cytologically, two species of Castellani are so poorly described that they can be referred here only on the basis of the lesions caused and may even be synomyms of later but better described species. Two other species of MacCarthy, *E. gypseum* and *E. niveum*, are very close in characters of the giant colony to *Ectotrichophyton mentagrophytes* (*T. gypseum*) and *Ectotrichophyton felineum* (*T. niveum*) respectively and need further study before they are finally classified.

The remaining species form a compact group of closely allied species and show less degeneration in connection with specialized parasitism than do the other series.

Key to the Species of Epidermophyton

- Colony white, becoming pale yellowish green, never pink or reddish.
  - Closterospores absent.
    - Colony white or gray, cerebriform, not velvety, no pleomorphism. *E. cerebriforme.*
    - Colony clear white, with concentric elevations and depressions, reverse brownish, long fine white velvet, no pleomorphism. *E. niveum.*
    - Colony yellow cream color, with long white velvet; reverse brownish or violaceous, pleomorphic in two or three weeks. *E. pedis.*
    - Colony white becoming café-au-lait color, with a slight central crater with flexuous radial furrows, powdery, pleomorphic in five weeks. *E. gypseum.*
  - Closterospores present.
    - Growth rapid, pale buff boss, rest white; on glucose media reverse chestnut brown to almost black with a yellowish margin; inoculable into experimental animals, lesion evanescent, aleurospores present; spirals on Sabouraud agar. *E. interdigitale.*
    - Growth slow, greenish yellow, radially furrowed, reverse concolorous; inoculable into experimental animals with great difficulty if at all; aleurospores very rare; spirals only on complex carbohydrate media. *E. floccosum.*
- Colony some shade of pink, at least when freshly isolated.
  - Colony multizonate, alternating white and purple zones.
    - Central umbo white with 20 radial furrows, margin purple, pleomorphism in 65 days, pigment diffusing on potato; reverse red brown. *E. plurizoniforme.*
    - Central crater rose purple without radial furrows, margin yellowish white; no pleomorphism; pigment not diffusing; reverse concolorous on sugar media, red brown on peptone. *E. lanoroseum.*
  - Colony not multizonate, never more than three zones.
    - Center convex, fire red with a salmon border; growth rapid (7 cm. in 11 days), pleomorphism in 16 days on glucose, slight diffusion of pigment in freshly isolated colony; hard papules, coriaceous; peculiar odor in lesion. *E. salmoneum.*

Center hemispheric, long white velvet in which red purple color begins at surface of medium and gradually extends to the surface of the colony, growth slow (7 cm. in 40 days), pleomorphism not observed, pigment not diffusing; reverse concolorous; usual type of tinea cruris; inoculable into guinea pig. *E. purpureum.*

Colony shape not given, creamy white with a port wine tint, short velvet, growth rapid, pleomorphism early, pigment port wine diffusing in glucose not in maltose agar; closterospores rare, nodular organs present, chlamydospores abundant; usual type of tinea cruris, partly pustular; not inoculable into experimental animals. *E. rubidum.*

Center small, convex, rose lilac to wine color, growth slow, pleomorphism early, pigment not diffusing; colony polygonal to star-shaped on Sabouraud conservation agar; pleomorphic colonies plurizonate, of elevated and depressed zones; lesions of glabrous skin and of palmar and plantar surfaces; inoculation of guinea pig difficult. *E. persicolor.*

Central knob on both glucose and maltose agar, whitish or dirty yellowish, becoming pale rose; growth and pleomorphism slow, on Sabouraud glucose, rose tinged with violet; reverse yellowish brown with dirty yellowish margin; closterospores absent, chlamydospores abundant; aleurospores, spiral hyphae and nodular organs present; tinea cruris. *Atcleothylax Viannai* (p. 431).

Central knob on glucose, crateriform on maltose, delicate white velvet, growth slow, pleomorphism present, pigment diffusing, closterospores and chlamydospores abundant, aleurospores not mentioned, tinea cruris.

Deep red, growth slow. *E. rubrum.*

Delicate pink, growth rapid. *E. Perneti.*

Epidermophyton cerebriforme Dodge, n. sp.

Epidermophyton sp. [C. Die cerebriforme, glatte, grau-weisse Kultur] Cremer, Arch. Derm. Syphilis **169**: 256, 257, 1933.

Isolated from epidermophytosis of hands and feet. In guinea pigs producing crusts which heal spontaneously in a week, without infecting the hair.

Aleurospores and chlamydospores abundant, spirals and closterospores seen only in one case.

Colony cottony at first becoming smooth, center elevated, cerebriform with a flat margin, white finally becoming grayish. On conservation agar, colony remains white, center not elevated, very much folded, margins elevated, only slightly or not at all cottony. No trace of pleomorphism.

It is probable that the gray white cerebriform strains which various German workers have referred to *E. floccosum* or its synonyms belong here.

Epidermophyton niveum MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 41-44, *Pl. 4,* 1925.

Trichophyton pedis Ota (1931) pro parte.

Isolated from pseudodysidrosis of plantar surfaces and interdigital spaces, also one case with infected toenails only. France.

Aleurospores small, 3-4μ, intercalary chlamydospores present.

On Sabouraud agars, central disc surrounded by concentric rings of depressions and elevations, snow white with long fine velvet; reverse brownish. No trace of pleomorphism was observed in 5 months.

Epidermophyton pedis (Ota) Dodge, n. comb.

Trichophyton pedis Ota, Bull. Soc. Path. Exot. **15**: 594-596, *Fig. 4,* 1922.

Trichophyton sp. Kaufmann-Wolf, Derm. Zeitschr. **21**: 385-396, *Pls. 8, 9,* 1914.

Trichophyton niveum Hodges (1921) pro parte.

?*Trichophyton purpureum* var. *I* Takahashi, Jap. Jour. Derm. Urol. **25**: [73.] 1925.

Isolated from lesions on the foot in man, inoculable into guinea pig, producing ectothrix type of lesion.

Aleurospores 3-4.5μ, pyriform on simple hyphae, occasionally on compound thyrses; arthrospores ovoid, or spherical, 3-8μ in diameter.

Colony small, center elevated, yellowish cream color; reverse violaceous or brownish; growth rapid, pleomorphism in 2-3 weeks.

The species seems intermediate in most of its characters between *E. niveum* and *E. gypseum,* perhaps the "arthrospores" should be considered chlamydospores. No cytologic details given.

Epidermophyton gypseum MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 37-41, *Pl. 3,* 1925.

?*Trichophyton interdigitale* var. *4,* Ota, Arch. Derm. Syphilol. **5**: 708, 709, 1922.

?*Trichophyton interdigitale* var. *II* Takahashi, Jap. Jour. Derm. Urol. **25**: [74], 1925.

Isolated from two cases of pseudodysidrosis with extended lesions on the palms of the hands and the soles of the feet and invading the interdigital spaces; chronic and resisted all treatment; another case of Carrión (1930) either this species or closely related, from Porto Rico. Inoculable in rabbits and guinea pigs. In 6 days, point is red, infiltrated and scaly; fourteenth day thick yellowish crust, surrounding several hairs, falls leaving an erythematous infiltrated surface. Lesions completely healed in 21 days.

Aleurospores 3-4μ, pyriform and attached by very thin sterigmata to filaments of medium length; compound thyrses numerous; chlamydospores terminal or intercalary, other types of reproductive organs absent.

Colony at first white disc, slightly powdery, slightly depressed in the center and cut by flexuous radial folds; second week clear café-au-lait color, fourth week 10 cm., flat disc, color slightly deeper than earlier, powdery. Pleomorphism after 35 days on Sabouraud conservation agar, colony nearly circular, depressed in the center, cut by slight irregular furrows, white and velvety, never more than 5 cm. in diameter. On potato at 3 weeks, colony an irregular mass scarcely raised, velvety, 2 cm. in diameter.

The colony resembles *Ectotrichophyton lacticolor* but is less powdery, less like curdled milk in appearance.

Epidermophyton interdigitale (Priestley) MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 24, 1925.

Epidermophyton inguinale Sabouraud pro parte, Arch. Derm. Syphilis **113**: 923-934, *Pls. 36-40,* 1912.

Trichophyton interdigitale Priestley, Med. Jour. Australia **4**: 2: 475, 1917.

Sabouraudites interdigitalis Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

T. gypseum var. *2* Ota, Jap. Zeitschr. Derm. Urol. **20**: 1920.

T. gypseum var. *C.* Hodges, Arch. Derm. Syphilol. **4**: 1-28, *Figs. 1-12,* 1921.

Epidermophyton variabile Karrenberg, Arch. Derm. Syphilol. **17**: 519-532, 1928.

Probably the following also belong here:

Trichophyton interdigitale var. *Kaufmann-Wolf* Ota, Arch. Derm. Syphilol. **5**: 706-708, 1922.

T. granulosum Kamabayashi, Jap. Zeitschr. Derm. Urol. **19**: 1919 (fide Ota, 1. c.).

T. gypseum var. *3* Ota, Jap. Zeitschr. Derm. Urol. **20**: 1920.

E. inguinale Kurotchkin & Chen, Nat. Med. Jour. China **17**: 521-528, *6 pls.,* 1931.

Typically producing macerated or dysidrosiform lesions in the interdigital spaces, reported also from a scaly lesion in the groin. This species is close to *T. floccosum* and has often been confused with it when the cultures have not been studied critically. Some slight variants have been reported, but until there has been a much more thorough study of the etiology of these lesions both from the groin and interdigital spaces the confusion will continue. Inoculable into experimental animals, producing an evanescent, scaly, erythematous lesion, not infecting the hair. Common in Australia, Germany, United States, Spain, Argentina, São Paulo, in Brazil, Shanghai, Japan (?).

Closterospores present, multiseptate, gradually giving way to chlamydospores in old cultures, compound thyrses of aleurospores and some spiral hyphae present. (Descriptions of morphology brief and unsatisfactory, nothing known of cytology.)

On Sabouraud agar, growth is much more rapid than in *E. floccosum.* Central boss obscured by pale buff velvet, the rest white velvet, reverse not colored. On glucose agar, boss surrounded by a light buff area with a white periphery, little velvet, colony suggesting a piece of blotting paper, reverse chestnut brown, nearly black in the center with a yellowish periphery, soon becomes pleomorphic. On nutrient agar is a flat white growth with a medium velvet. On potato, abundant white growth with short velvet. On Pollacci agar, central area cerebriform with flat margin, surface dry, powdery grayish white, reddening (fide Bruhns & Alexander 1928). Keller reports several variations, a cottony form, a powdery, yellowish colony and a cerebriform, grayish white becoming reddish.

The fungus described by Kaufmann-Wolf (1914), usually referred here, belongs in *E. pedis,* since it produced no closterospores.

Epidermophyton floccosum (Harz) Langeron & Milochevitch, Ann. Parasitol. Hum. Comp. **8**: 495-497, 1930.

Acrothecium floccosum Harz, Bull. Soc. Imp. Nat. Moscou **44**: 124, *Pl. 4, Fig. 9,* 1871 [reprint p. 37].

Blastotrichum floccosum Berlese & Voglino, in Saccardo, Sylloge Fungorum **4**: Additamenta: 376, 1886.

Dactylium ? floccosum Sartory, Champ. Paras. Homme Anim. 871, 1923.

Trichophyton sp. Sabouraud, Pratique Dermatol. **4**: 497, 1904; Castellani, Brit. Med. Jour. **2**: 1277, *Fig. 1,* 1905.

Trichophyton intertriginis Sabouraud, Dermatol. Topographique 300, 1905; Photinos, Contr. Etude . . . Affect. Cutan . . . Région Inguino-crurale 51, *1 fig.,* 1906.

Trichophyton inguinale Sabouraud, Arch. Méd. Expérim. Anat. Path. **19**: 565-586, 737-766, *Pls. 17, 18,* 1907.

Epidermophyton inguinale Sabouraud, Maladies du cuir chevelu **3**: 420-444, 1910.

Trycophyton cruris Castellani, Jour. Trop. Med. Hyg. **11**: 262, 1908.

Epidermophyton cruris Castellani & Chalmers, Man. Trop. Med. 609, 610, 1910.

Trichophyton Castellanii Brooke.*

Epidermophyton plicarum Nicolau, Ann. Derm. Syphiligr. V, **4**: 65-87, *Figs. 1-12,* 1913.

Closterosporia inguinalis Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 411, 1925.

Microsporum (*Closterosporia*) *inguinale* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Fusoma cruris Vuillemin, C. R. Acad. Sci. **189**: 405, 1929.

Producing eczema marginatum of Hebra who gave the first full clinical description in 1860. It had previously been recognized by Devergie in France as early as 1857, and its mycotic nature described. Köbner in 1864 described mycelium and performed inoculation experiments. His work was confirmed by Pick in 1869. Harz in 1871 first described the closterospores and gave the fungus a name, although his work was overlooked by subsequent authors until 1930. Sabouraud cultivated the organism as early as 1895 and figured it in 1904, but it was not until his classic paper in 1907 that the organism was fully and carefully described in culture. Apparently Castellani first encountered the organism in Ceylon in 1905 and first named it in 1908 in ignorance of the work of Harz and of Sabouraud. For a general discussion of eczema marginatum, see p. 436. In all this early work it should be borne in mind that it is possible that other species of *Epidermophyton* were involved, as the emphasis was clinical rather than mycologic, but in the absence of proof to the con-

---

*Owing to the extremely faulty bibliography of Castellani, I have so far been unable to trace the original description or proposal of the name *Trichophyton Castellanii* which is variously ascribed to Perry, Ceylon Med. Rept. 1907-08, and to Brooke 1908. However, an organism is described without name in the Internat. Cong. Dermatol. New York **6**: 665-667, 1908, which is reported by Castellani, *Jour. Trop. Med. Hyg.* **11**: 262, 266, 267, 1908 and *Arch. Derm. Syphilis* **93**: 38, 1908, as the cause of tinea intersecta on arms and trunk. This organism is later referred to *Epidermophyton cruris*, a synonym of *E. floccosum* by Castellani, probably wrongly since it was very superficial and without vesiculation. Apparently not cultivated, as the lesions disappeared when the Tamil coolie was scrubbed with soap and water.

trary, it seems safe to assume that this species was present, since it is the most common in the parts of Europe where the work was done.

Inoculations into guinea pig and even man, gave negative reactions in the early work. By keeping the epidermis moist, inoculation to man is easy, while inoculation of guinea pig is difficult. Common in England, France, and Austria, since the war of 1914-1918, endemic in Germany, United States, Brazil, Argentina, occasional in Spain, Hungary, China, and Japan.

Mycelium septate, branched, 3-6μ, mostly 3-4μ, tips swelling to form closterospores either singly or in groups of five to seven; closterospores 20-35 × 6-8μ, averaging 4-5 cells, cells varying from twice as long as wide to isodiametric, walls very thin, sessile or the basal cell elongate, simulating a pedicel. Repeated subculture on sugar media produces the usual pleomorphism with mycelium, 2-3μ, chlamydospores not rare, closterospores unicellular and arthrospores becoming very rare in cultures. Sabouraud reports that finally only aleurospores are produced, Grigorakis reports always finding a few closterospores, while Langeron & Milochevitch report that they were unable to find aleurospores on any medium. The latter authors report spirals on media prepared from cereals, dung, and dextrine + peptone.

Colonies greenish yellow (color of partially ripe citron) small, center elevated (suggesting a monk's hood), velvety, dry, powdery, seldom over 2 cm. in diameter, the number of radial furrows increasing with age. At 37° C., the colony becomes pointed and dark brown. Pleomorphism sets in in 3-4 weeks, hyphae white or gray, on subculture becoming snow white. On Sabouraud conservation agar, center broadly umbilicate with umbo, margin irregularly elevated, citron yellow, powdery, not pleomorphic. When pleomorphic mycelium is transferred to this medium lacking carbohydrate, the colonies are crackled, poor, soon dying. On Pollacci agar, colonies more greenish in color.

Var. **clypeiforme** (MacCarthy) Dodge, n. comb.

Epidermophyton clypeiforme MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 27-30, *Pl. 1*, 1925.

Isolated from sole of foot and between toes of a soldier. Inoculation of guinea pig unsuccessful. France, also reported from São Paulo, Brazil.

Hyphae 8-10μ in diameter, septa distant, only closterospores present.

Colony on eighth or ninth day, shows a slight grayish white tuft, on the eighteenth day is 2.5 cm. in diameter, central two-thirds grayish white, outer fringe greenish gray; a little later the central part of the culture takes the shape of a shield with a greenish yellow center covered with a velvet having the appearance of chamois, the outer centimeter is flat. Colony 5 cm. in 1 month, 8 cm. in 2 months, color a little deeper, especially on the margins, with no radial furrows. On Sabouraud conservation medium, growth about half as rapid, and after 3 weeks the center is irregularly depressed. On potato, less characteristic, a little less velvety, green color slightly more marked than on other media.

Epidermophyton plurizoniforme MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 31-37, *Pl. 2*, 1925.

Sabouraudites plurizoniformis Brumpt, Précis Parasitol. ed. 4, 1291, 1927.

Isolated from eczema of feet and palms of Irishwoman in France, also reported from São Paulo, Brazil.

Mycelium with aleurospores 3-4 × 7μ, compound thyrses large; closterospores 10-30μ long, 3-12 septate; chlamydospores 10-15μ.

In 40 days, colonies zonate, white, velvety, 4 cm., with central umbo the size of a petit pois, intermediate zone 1.5 cm., purple red, velvet scarcely visible, fine, margin of fine radiating hyphae; radial furrows about 20; reverse red brown. In 75 days, central zone rosy white 5 cm.—purple ring 0.5 cm.—rosy white 2 cm.—purple ring 1 cm.— rosy white 1 cm.—red zone 1 cm.—yellowish margin 1 cm.; reverse entirely purple except outer 2 cm.; pleomorphism appears on sixty-fifth day.

On Sabouraud conservation agar in 25 days, central tuft snow white, with an area one-third the whole, also white, surrounding it; outer zone yellowish. After the twenty-fifth day, the outer zone begins to turn red and in 4-5 days, whole colony is purple red; after 2 weeks becoming black violet. On potato, after 60 days, white center and purple red margin, pigment diffusing along the potato about 1 cm.

Epidermophyton lanoroseum MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 49-53, *Pl. 6*, 1925.

Trichophyton rubidum Ota (1931) pro parte.

Isolated from a case of generalized epidermomycosis reported by Montlaur & Dumet, Premier Cong. Derm. Syphiligr. Lang. Franç. 38-40, 1922 as being caused by *E. rubrum*. Lesions developed during the patient's return from Portuguese Guinea.

Aleurospores small, pyriform, compound thyrses rare; long closterospores uni- or pluriseptate.

On forty-fifth day, surface woolly with about 8 radial furrows, central zone 2 cm., white, depressed at center surrounded by a rose ring 1 cm.—white ring 2 cm.—rose purple ring, not velvety 0.5 cm.; margin 1 cm. yellowish white; reverse concolorous; no pleomorphism in 7 months. On Sabouraud conservation agar, colony similar but growth slower, hence fewer zones, no increase in diameter after 30 days; reverse red brown.

Epidermophyton salmoneum Froilano de Mello, C. R. Soc. Biol. **84**: 239, 240, 1921.

Isolated from inguinal lesions, large, hard, almost coriaceous papules with wine red center and lighter toward the periphery, very pruriginous, exuding a viscous fluid with a peculiar odor.

Closterospores present and variable.

On Sabouraud glucose agar on eighth day, colony dry, colorless, more or less glistening, center rounded elevation, margin with divergent radiations.

The culture assumes a rose tone, becoming salmon on the twelfth day, with a deeper fire-colored center. Pleomorphism begins on the sixteenth day. When first isolated, the colony is purplish and turns the medium slightly purple. On Sabouraud conservation agar with peptone 4%, colony moist, shining, pearl gray, velvety, rounded and radiating, on the eighth day becoming darker, almost brownish. On carrot, velvety, rose after first day, salmon fourth day, and pleomorphic on the tenth day. Similar on potato, but on tenth day, colony is rose-salmon, crateriform with a cerebriform margin. Colony diameter 1 cm. in 24 hours, 2 cm. in 48 hours, 3 cm. in 4 days, 5 cm. in 9 days, 7 cm. in 11 days.

Epidermophyton purpureum (Bang) Dodge, n. comb.

Trichophyton purpureum Bang, Ann. Derm. Syphiligr. V, **1**: 224-238, *Figs. 1-7,* 1910.

Isolated from tinea cruris, spreading to thighs, buttocks, scrotum but not to pubis. One patient, a Dane, acquired the disease in America, the other patient, a Mexican; lesions healed by pomade containing 1% chrysarobin. Harris & Lewis (1930) report a case of subcutaneous granuloma from which this organism was isolated. Probably cases from southern United States, Porto Rico, the states of Amazonas and São Paulo in Brazil, Uruguay, and Buenos Aires, Argentina belong here, although they usually appear under the name *E. rubrum* in the literature. Inoculation of guinea pig and rabbit by a harsh shave and rubbing in the mycelium and spores from the culture. Lesion develops on the eleventh day and disappears in the fourth week, organism recovered.

Mycelium 2-3 cm. in diameter; cells 2.5 times as long as thick, when young, becoming isodiametric when old; aleurospores small, 4-5 × 2.5μ, pyriform, on compound thyrses on the eighth or ninth day; closterospores on the tenth to twelfth day, 4-8 celled as in *Ectotrichophyton mentagrophytes,* borne both terminally and laterally; chlamydospores occurring abundantly in old cultures.

Growth evident on sixth to eighth day, white, size of a 50 centime piece in 10 days; colony hemispheric with long white velvet; on the tenth to twelfth day, the lower portion of the colony becomes red purple which gradually extends upward; on the twentieth day, the colony has a white center surrounded by a powdery zone, 5-6 mm. broad, neutral in color, due to the pigment formation below. On Sabouraud glucose, growth slower, slight radial folds near the margin, purple pigment not diffusing into the medium; reverse purple. On Sabouraud conservation agar with 3% peptone, on twenty-fifth day, colony hemispheric, grayish white; on fortieth day, 5 cm. in diameter, center covered by white velvet, elevated, surrounded by circular furrow with radial folds, outer zone gray or slightly bister and powdery with margin 5 mm. broad, slightly velvety and white; reverse margin not colored.

Very old cultures fail to produce the typical center, but inoculation into and reisolation from guinea pig renews this power.

Muskatblit (1933) in comparing this species with *E. rubrum* describes his cultures as follows: Mycelium straight, more regular, chlamydospores much less numerous, closterospores few and poorly developed; aleurospores abundant, borne on either simple or compound thyrses; arthrospores occasional. His cultural characters agree well with Bang's description.

Epidermophyton rubidum (Priestley) Dodge, n. comb.

Trichophyton rubidum Priestley, Med. Jour. Australia **4**: 2: 474, 1917.

Trichophyton purpureum var. *II* Takahashi, Jap. Jour. Derm. Urol. **25**: [74], 1925.

Isolated from an extensive erythrosquamous eruption over both buttocks, the inguinal region, the lumbar region, and the side of the neck. The lesion was pustular in parts. Reinfected man and recovered the organism, but not transmitted to animals. Healed by application of tincture of iodine.

Aleurospores borne in compound thyrses, closterospores occasional, not well developed; nodular organs occasional; chlamydospores common in old cultures, very irregular in form.

Colony creamy white, short velvet, medium not discolored, except glucose agar which shows port wine discoloration, very dark under the center. Nutrient agar growth slow, yellow, slightly reddish in the center, pleomorphic degeneration early. Also some small buff flat colonies, without velvet, never 1 cm. in diameter.

The position of this organism is somewhat doubtful; while the small buff colonies suggest *Favotrichophyton*, the pustular lesion occurring on the neck as well as in the inguinocrural region and the occurrence of nodular organs suggest *Ectotrichophyton*. The organism needs much further study both in clinic and in culture.

Epidermophyton persicolor (Sabouraud) Dodge, n. comb.

Trichophyton persicolor Sabouraud, Maladies du cuir chevelu **3**: 371-374, 1910.

Ectotrichophyton (*Microtrichophyton*) *persicolor* Castellani & Chalmers, Man. Trop. Med. ed. 3, 1005, 1006, 1919.

Sabouraudites (*Aleuramma*) *persicolor* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Microsporum (*Closteroaleurosporia*) *persicolor* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Perhaps first seen by Adamson in a palmar trichophytosis, probably of tropical origin, since he mentions a peach-colored colony; first described by Sabouraud from the almost glabrous chin of a young man of 20 (gonadal deficiency?) and from vesiculose lesions on the palmar surface of a man of 45. Montpellier & Matamoros (1927) report a case involving the pubocrural region. Inoculation into guinea pig very difficult; the hair and hair follicle never infected in man or guinea pig.

Closterospores present but not abundant, beginnings of nodular organs on Sabouraud conservation medium, but less highly developed, usually involving only one or two closterospores.

Growth best on conservation media, rose lilac, wine color, surface of loose felt, closely suggesting the skin of a peach. Colony at first round, becoming polygonal, or star-shaped, divided by radial furrows. On peptone media, 5 cm. in diameter, margins fimbriate, surface marked by concentric zones of a deeper color. On sugar media, colonies more round, powdery, rose color, scarcely 4 cm. before pleomorphic velvet develops. Pleomorphic colonies of white velvet, with alternate elevated and depressed concentric zones.

This species was considered of doubtful position when originally described. The type of lesion is much closer to that of the species of *Epidermophyton*. It has not been found in the hair and rarely in the hair follicle. In pus formation it is intermediate between *E. salmoneum* and *E. rubidum*. In its cultural and morphologic characters, it is very close to the latter. Only a careful comparison of the two organisms can determine whether they are identical.

Under the name *T. pedis* var. *β*. Ota described an organism, found in about half the cases of tinea interdigitalis (Hongkong foot) investigated by Kurotchkin & Chen (1930), which might belong here. At first colony of long white velvet which after two months became much shorter, with a deep red undergrowth, giving successively a pinkish, reddish purple, and deep purple color. Aleurospores in simple or compound thyrses. Colony 4-5 cm. in 20 days, round, flat, sometimes with superficial radial furrows.

Epidermophyton rubrum Castellani, Brit. Jour. Derm. Syphilis **22**: 147-151, *1 pl.,* 1910; Philippine Jour. Sci. B **5**: 203-206, *1 pl.,* 1910; Castellani & Chalmers, Man. Trop. Med. ed. 1, 610, 1910.

Sabouraudites ruber Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Trichophyton rubrum Semon, Brit. Jour. Derm. Syphilis **34**: 398, 1922.

Originally described from eczematoid tinea cruris in Ceylon. Spaar reports a case of pruritic eruption on the buttocks. Silva reports successful inoculation and recovery of the organism from a case of dhobie itch (eczema marginatum) while Ashford, McKinley & Dowling (1930) report that it was not inoculable into *Silenus rhesus* (perhaps these authors were working with *E. purpureum*).

In scales, arthrospores 4-5μ, spherical, mycelium 2-3.5μ; morphology in culture unknown.

On glucose agar, growth in 5 days as white knob, slowly spreading, red pigment develops gradually. On maltose agar (2%), colony whitish, powdery, with a central umbilicus, sometimes red on 4% maltose. Glycerol agar, thick central growth with thin outer zone, margin greenish. On Sabouraud broth, colony forms a white pellicle which slowly becomes red; on peptone water, a white pellicle without pigment. On sucrose agar, a white knob, a yellowish zone and white margin. [Spaar reports on Sabouraud maltose agar, growth in 3-6 days, colony reddish becoming darker, crateriform or with central knob, covered with delicate white velvet; on 4% glucose, best growth, deep red, color diffusing to media in old culture, the whitish velvet may hide the red color.] On ordinary agar, white colonies with central knob and greenish margin, no red pigment.

This species has often been confused with *E. purpureum* (Bang) Dodge which was published with a much more complete description within a few weeks. This name has been used for several species with red colonies, generally causing lesions in the epidermis, and Kato has reported a fungus by this name from tinea tonsurans of the endothrix type (perhaps a red member of the *Favotrichophyton violaceum* group). Such reductions to synonymy as those of Hashimoto, Irizawa, and Ota (1930) which show no evidence of a careful study of cultures referable to the various descriptions, are only confusing. Their white variety differs in cultural characters and in ability to infect guinea pigs from both species to which they refer it as synonyms and seems to be a species of *Ectotrichophyton* (see *E. Otae*, p. 500).

Recently Muskatblit (1933) has made a comparative study of strains which he has referred to *E. purpureum* and *E. rubrum*. He describes *E. rubrum* as follows: Mycelium frequently tortuous, thick and irregular, with numerous chlamydospores and large closterospores with blunt ends and thin smooth walls; aleurospores not reported. Colony has a central knob with a smooth, irregular surface and waxy yellowish becoming cerebriform, powdery, the convolutions tending to become deep radial furrows toward the margin which is flat and even, center deep red becoming lighter toward the periphery, pigment slightly diffusing into the medium; finally develops pleomorphic mycelium. On conservation agar, colony similar but yellowish with a lilac color in the center.

Epidermophyton Perneti Castellani, Brit. Jour. Derm. Syphilis **22**: 148, 1910; Castellani & Chalmers, Man. Trop. Med. ed. 1, 610, 1910.

"Growth more rapid than in *E. cruris.* [*E. floccosum.*] Colonies on maltose a delicate pink, rare, color disappearing in subcultures."

The above description is too brief to be of any value in view of the number of species of this genus which have pinkish colonies. It might be pointed out that this specific name antedates all others in the group and that this name, not *rubrum,* must be used by those who would unite these species with pink and red colonies.

Doubtful Species

The following species have been too poorly described to place definitely. Perhaps they belong in *Epidermophyton.*

Trichophyton ceylonense Castellani, Jour. Trop. Med. Hyg. **11**: 261-268, *1 pl.,* 1908; Arch. Derm. Syphilis **93**: 40, 41, 1908.

Atrichophyton ceylonense Castellani & Chalmers, Man. Trop. Med. ed. 3, 1009, 1919.

Reported as the cause of tinea nigromarginata, causing thick, reddish, elevated rings, darker in the center, with pruritus on scrotum and neck, Ceylon.

In scrapings, hyphae straight, occasionally dichotomous; spores rare, 4-6μ, thick-walled.

Not isolated. Since a score or more dermatophytes produce similar hyphae in scrapings, this name might well be permanently dropped from the literature in accordance with the provision of the International Rules of Nomenclature for names which can only be a permanent source of confusion. See also Brochet & Wilhelm (1932), which is said to deal with this species. I have been unable to procure a copy.

Trichophyton amethysticum Williams, Arch. Derm. Syphilol. **5**: 161-173, *4 figs.*, 1922 (nomen nudum).

Microsporum amethysticum Weidman, fide Bruhns & Alexander in Jadassohn, Handb. d. Haut- u. Geschlechtskrankh. **11**: 145, 1928.

Lesions on hands or feet. I have not been able to find further mention of this organism; perhaps it is a strain of *E. purpureum,* which was given a temporary name for purposes of tabulation. Evidently it is not *Favotrichophyton violaceum,* which is mentioned in the same table.

Excluded Species

Epidermophyton repens (Eklund) Sartory, Champ. Paras. Homme Anim. 516, 1922.

Lepocolla repens Eklund, Ann. Derm. Syphiligr. I, **2**: 197-203, 1883.

Achorion repens Guéguen.

Isolated from psoriatic lesions and cultivated in liquid media. Hyphae were reported as 0.6-0.8μ in diameter, which would suggest *Actinomyces* rather than *Epidermophyton.* The description is too poor to have any value, and this name may well be dropped as a permanent source of confusion.

Whether *Epidermidophyton* Lang, Klin. Vorträge 7 *ser.* **208**: 1765-1788, *8 figs.,* 1879, refers to the same organism is doubtful. From time to time various fungi have been reported from psoriatic lesions, but probably all are either secondary invaders or cultural contaminants.

ENDODERMOPHYTON

Endodermophyton Perry, 1907; Castellani & Chalmers, Man. Trop. Med. ed. 1, 610, 1910.

The type species is *Endodermophyton concentricum* (Blanchard) Castellani & Chalmers.

So far I have been unable to locate the original place of publication of this genus name, owing to the poor bibliography of Castellani. The cultural characters were first correctly and completely described by Nieuwenhuis (1898), although he did not name the organism. Earlier workers had isolated species of *Aspergillus* (probably contaminants).

Mycelium producing chlamydospores or thick-walled arthrospores which function as chlamydospores. Other spore forms not seen; giant colonies flat, folded sometimes moist; producing scaling of epidermis with pruritus but no inflammation.

Endodermophyton africanum, Dodge, n. sp.

Endodermophyton sp. Pijper. Jour. Trop. Med. Hyg. **21**: 45-47, 1918.

Greater portion of body, except face and scalp, covered with scales overlapping like tiles of a house, accompanied by pruritus.

Only mycelium produced on ordinary agar.

Difficult to free from bacteria. Pijper grew the contaminating bacteria on media in incubator for twelve hours, then sterilized it, and added glucose and calcium carbonate. The contaminating bacteria then failed to grow and the fungus developed from scales.

Colony circular, white in ten days, becoming gray crateriform, crater wide, narrow flat margin, outside crater reddish. Reverse center green, margin reddish. On Sabouraud conservation agar, no growth. On maltose agar, growth more rapid, color darker, nearly black in 41 days, with red margins, radial furrows present. On glucose agar, growth slow, slightly gray zone between white center and margin; no crater. On mannite agar, as in maltose, but darker, growth more luxuriant. On lactose agar, red center, gray margin after 15 days. On glycerol agar, small, pure white, crateriform. On gelatin, light gray, flat colony. No liquefaction.

Endodermophyton concentricum (Blanchard) Castellani & Chalmers, Man. Trop. Med. ed. 1, 610, 1910; Jour. Trop. Med. Hyg. **13**: 370-372, 1910.

Trichophyton concentricum Blanchard in Bouchard, Traité Path. Gén. **2**: 916-919, 1896.

Aspergillus concentricum Castellani, Trans. Intern. Derm. Cong. **6**: 667-671, *Pls. 49, 50,* 1907.

Oospora conzentrica Hanawa & Nagai, Jap. Zeitschr. Derm. Urol. Ergänzungsband, 47-84, 1917 [Festschr. Keizo Dohi].

Achorion (Endodermophyton) concentricum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Mycoderma concentricum Vuillemin, C. R. Acad. Sci. **189**: 405, 1929.

Trichophyton Mansoni Castellani, Brit. Med. Jour. **2**: 1277-1279, *4 figs.,* 1905.

Endodermophyton Mansoni Brumpt, Précis Parasitol. ed. 4, 1299, 1927.

Endodermophyton Castellanii Perry, Ceylon Med. Rept. 1907; fide Castellani & Chalmers, Man. Trop. Med. ed. 1, 1910.

The following names are reported from cases of tinea imbricata, but probably represent fungus hyphae seen in the scales or contaminations:

Lepidophyton sp. Tribondeau, Arch. Med. Navale **72**: 5-52, 1899.

Lepidophyton concentricum Gedoelst, Champ. Paras. Homme Anim. Domest. 147-149, 1902.

Aspergillus lepidophyton Pinoy, Bull. Inst. Pasteur **1**: 761-774, 1903.

Aspergillus tokelau Wehmer, Centralbl. Bakt. I, **35**: 140, 1903.

Producing tinea imbricata (see p. 436). The original cultures carefully described from cases from Java by Nieuwenhuis (1898), but the name was based on a case from Ceylon briefly described, without reference to earlier literature, by Castellani. Later reported by Castellani to be the rarest of the three species causing tinea imbricata.

In scales, cells cylindric, 2.5-3μ, rather longer from cultures, only arthrospores produced. In cultures the hyphae are septate, 3-4.5μ in diameter, dichotomous. Chlamydospores terminal, 6-9μ, or lateral, occasionally intercalary. On lactose agar, cells more irregular in shape and chlamydospores of greater diameter, 18-21μ.

On 4% glucose agar, growth abundant, cerebriform or crinkled, dirty white becoming light amber or bright brown, with no velvet. On Sabouraud maltose agar, growth very scanty, light gray, mostly submerged, with small central knob, the submerged portion firmly embedded with deep projections, color of medium unchanged. Mannite and adonite agar similar to glucose agar, but growth less abundant and lighter in color. Sucrose gives the most luxuriant growth, similar to glucose agar. Glycerol, nutrose, plain, maltose, galactose, fructose, raffinose, and inulin agars similar to Sabouraud agar. On potato, a gray white uneven mass, elevated 5-6 mm. above the surface with colony only 8 mm. in diameter. Gelatin slowly liquefied. Sugars not fermented nor acid produced. A sediment, but no pellicle, in liquid media.

Nieuwenhuis (1898) reports successful human inoculations and gives a clear account of the development of the lesions. Castellani (1910) and Hanawa & Nagai (1917) also reported human inoculation. Ota & Kawatsuré who consider this organism the same as *E. indicum* report that they succeeded in inoculating guinea pigs with three strains, the lesions being of the endothrix microïde type.

Endodermophyton indicum Castellani, Jour. Trop. Med. Hyg. **14**: 81-83, 146, 1911.

Arthrosporia indica Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 414, 1925.

Achorion (Endodermophyton) indicum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Endodermophyton concentricum Ota & Kawatsuré (pro parte), Ann. Parasitol. Hum. Comp. **9**: 144-161, *Pls. 2, 3,* 1931.

Frequently isolated from tinea imbricata in Malaysia.

Mycelium of cells up to 5μ, spherical becoming ovoid or even cylindric. As the mycelium ages, the cells become detached as thick-walled arthrospores. Other hyphae, somewhat larger in diameter, have the ends of the cells slightly inflated, suggesting the mycelium of some species of *Madurella.* A few slender hyphae may be seen. All cells observed are 2-5-nucleate. Germination of arthrospores similar to that of chlamydospores in other dermatophytes.

Growth slow, surface powdery, white, either with central knob or furrowed, not deepening in medium. On 4% glucose agar, growth fairly abundant, surface convoluted or furrowed, central portion deep orange, pinkish orange, or reddish orange, the rest of the colony white and powdery with a short delicate velvet. On sucrose and other sugar media, cerebriform, covered with a white velvet. On glycerol, growth abundant, yellowish or amber; partly covered by a short white velvet. Gelatin very slowly liquefied. No fermentation or acid production with sugars. The white velvet is more abundant on alkaline media, the colony moister on acid media.

Ota & Kawatsuré who received cultures from Castellani were unable to distinguish this species from *E. concentricum.*

Endodermophyton tropicale Castellani & Chalmers, Man. Trop. Med. ed. 3, 1017-1020, 1919.

Arthrosporia tropicalis Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 414, 1925.

Isolated from tinea imbricata and said to be the commonest species in Ceylon.

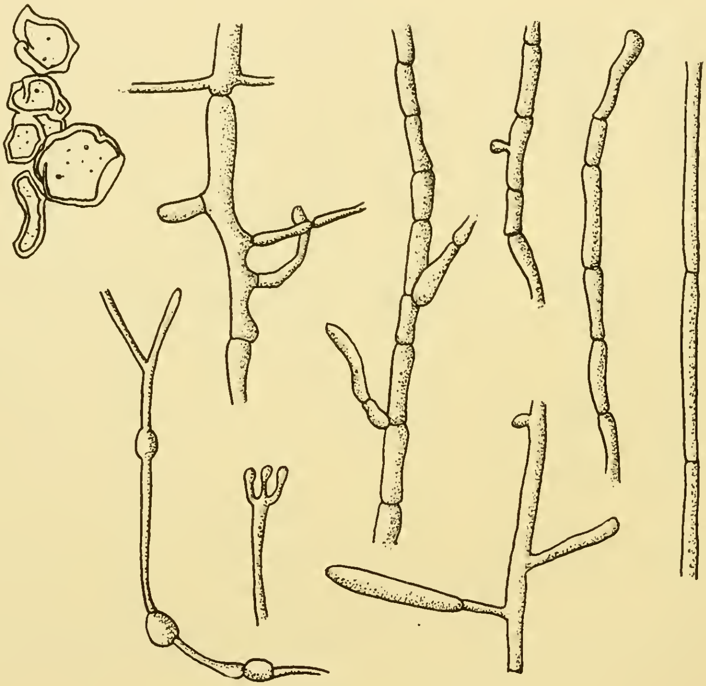

Fig. 85.—*Endodermophyton Roquettei.*

On 4% glucose agar, growth abundant, surface cerebriform or crinkled, slight amber in color, becoming deeper in age, velvet absent or very slight. On Sabouraud agar, growth scanty, light gray, mostly submerged, with a central knob with projections deepening in medium, no velvet. Other sugar media similar to glucose agar. Gelatin slowly liquefied, slight growth on milk, no fermentation.

Most recent authors, as Langeron & Milochevitch (1930) and Ota & Kawatsuré (1931), have regarded this a synonym of *E. concentricum.*

Endodermophyton Roquettei Fonseca, C. R. Soc. Biol. **92**: 305, 306, 1925 [clinical description, Sciencia Med. **2**: 615-617, *2 pls.,* 1924].

Mycoderma Roquettei Vuillemin, C. R. Acad. Sci. **189**: 405, 1929.

An endemic disease of the Purú Borá Indians along the Río San Miguel, Matto Grosso, Brazil. The plaques are confluent, circinate, squamose, achromic, on the face, neck, and front of the thorax. The scales are easily detached over the surface of the lesion, white or colorless, from less than 1 mm. to 5 mm. in diameter. There is no abnormal pigmentation. The native name of the disease is chimbêrê or báanêcêdútú. Ota & Kawatsuré (1931) succeeded in both human and animal inoculation. In experimental animals, the lesions were similar to *Ectotrichophyton* in the hair.

Both terminal and intercalary chlamydospores present in cultures (Fig. 85). Colonies cerebriform, humid, yellow, sometimes reddish, elevated.

ECTOTRICHOPHYTON

Ectotrichophyton Castellani & Chalmers, Man. Trop. Med. ed. 3, 1003-1008, 1919 (pro parte majore) ; Neveu-Lemaire, Précis Parasitol. Hum. 51-53, 1921.

Microtrichophyton Neveu-Lemaire, Précis Parasitol. Hum. 53, 54, 1921.

Spiralia Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 409, 1925.

Type species: *Ectotrichophyton mentagrophytes* (Robin) Castellani & Chalmers (*Trichophyton gypseum* Bodin, *T. asteroides* Sabouraud).

Mycelium dimorphic, spirals, closterospores (or nodular organs derived from them), chlamydospores and aleurospores present; giant colonies usually powdery, rarely velvety; producing suppurating lesions in the horny layer of the mammalian epidermis, invading the hair follicle and often surrounding the hair with a sheath of mycelium and small spores, not penetrating the hair itself.

This genus was originally based on all of the ectothrix species of *Trichophyton.* Castellani & Chalmers divided the genus into three subgenera: *Microtrichophyton, Euectotrichophyton,* and *Favotrichophyton,* the first group being the larger. Neveu-Lemaire, two years later, decided to split the genus still further. Instead of retaining the name for the section *Euectotrichophyton* in accordance with the usual practice of botanists, he retained the name for the section *Microtrichophyton* which contained the largest number of species, a procedure often recommended by botanists, since it results in fewer new combinations of names. Neveu-Lemaire then proceeded to use *Microtrichophyton* for *Trichophyton felineum* and *T. denticulatum* (the *T. niveum* group of Sabouraud). Subsequent work by Langeron and Milochevitch showed that this species is closely related to the *E. mentagrophytes* group by its morphology, as well as by the type of lesion caused.

Grigorakis based his genus *Spiralia* on three species: *S. mentagrophytes* (Robin) Grigorakis (1932), *S. asteroides* (Sabouraud) Grigorakis (1925), and *S. radiolata* (here treated as a variety of *E. mentagrophytes*). As originally described, the genus was separated solely on the presence of spiral hyphae. This character, as Grigorakis used it, is insufficient, but the further work of Langeron

& Milochevitch has shown spirals to occur on other media for the greater portion of the natural group separated by Sabouraud as the *Trichophyton* microïde group.

This genus is here conceived as the primitive group from which all the other dermatophytes were derived by degeneration. I have attempted to include all those species which have retained the closterospore or a nodular organ derived from it, where these organs are quite regularly produced in the fresh isolation. Very rarely a single author has remarked that in a single culture he found spirals or closterospores or nodular organs very degenerate, and that his organism was isolated from a relatively mild lesion. Such scattered species, which seem to have much closer affinities to the members of some other group, have been left with them. There remains a small residue of inadequately described organisms treated in the following key and descriptions, which have been referred here on the basis of lesion or colony character, but which might also be referred elsewhere and in most cases were not originally placed here by their author. It is to be hoped that some one will again find these organisms and give us further data on their morphology. *T. persicolor* Sabouraud has been referred to *Epidermophyton,* since it has not been found to penetrate the hair follicle and the type of lesion it causes seems rather closer to the usual lesion of *Epidermophyton.* Sabouraud (1910) remarked that in his microïde group the species was anomalous in several respects. The related group of pink and reddish species of *Epidermophyton* has been too poorly described to make clear the resemblance at that time.

The genus includes most of the kerion-producing organisms and many of those producing sycosis. The failure of hyphae to penetrate the hair or to form favic scutula easily distinguishes the lesions produced by *Ectotrichophyton* from suppurating lesions produced by *Microsporum* or *Achorion,* while the sheath of small spores and mycelium about the hair distinguishes the genus from *Epidermophyton.*

Key to Species

Clostospores absent, at least on Sabouraud sugar media, their functions apparently taken by the enlarged cells of the nodular organs; spirals often present, if not on Sabouraud media on other agars.
  Nodular organs present, formed of curved chains of chlamydospores usually a crateriform colony with radial folds.
    Powdery yellowish white disc with larger granules, center small, spirals on other media but not on Sabouraud; usually on horses, easily inoculable into guinea pig. *E. granulosum.*
    Smooth, light yellow green; light gray cerebriform on Sabouraud conservation agar; spirals not reported on any medium; on man; only slightly pathogenic for guinea pigs. *E. eriotrephon.*
    Dirty yellow becoming pale rose, center darker, powdery, acuminate, no radial furrows; tinea cruris. *Ateleothylax Viannai* (p. 431).
  Nodular organs not found on Sabouraud agar.
    Closterospores and spirals on various media but absent on Sabouraud, center long velvety, more or less crateriform, spirals and coremia abundant on cereal media. Margin with long slender rays. *E. felineum.*

Margin with short denticulations. *E. felinum* v. *denticulatum.*

Closterospores and spirals not reported on any media.

Crateriform; bottom of crater furrowed, cream color, margin white; on Sabouraud conservation agar central crater with subcerebriform irregular furrows, outermost zone ashy, intermediate zone whiter with about 16 radial furrows. *T. depressum* (p. 507).

Not cultivated on Sabouraud; on potato irregularly furrowed, white colony, yellowish pulverulent at the center, medium blackening; hyphal tips swollen. *Achorion Arloingi* (p. 507).

Colonies sulphur yellow; yellow on malt gelatin; aleurospores 2-3.5μ, occasionally chlamydospores present; sycosis. *Aleurisma Guilliermondi* (p. 508).

Colony white, hemispheric, yellowing and becoming crateriform in 10 days; aleurospores 1-2μ, chlamydospores abundant; tinea interdigitalis, ecto-endothrix in experimental animals. *Trichophyton chosenicum* (p. 508).

Closterospores present.

Spirals not reported on any media, lesions often superficial or vesicular; pleomorphism rapid.

Center umbilicate, dark brown, surrounded by a white plateau soon gray green, then lighter and slightly yellowish, outermost zone white. *E. griseum.*

Center flat, becoming irregularly folded in six weeks, gray with a white border, the medium colored violaceous. *E. griseum* var. *brasiliensis.*

Surface cerebriform, pulverulent, rosy with ochraceous tints toward center; becoming vinous, except center, which remains ochraceous; velvety, yellow ochre on Sabouraud conservation agar. *E. multicolor.*

Central knob surrounded by central plateau which becomes divided into two elevated zones by periclinal furrow, cut by four slight radial ridges; white; not inoculable to experimental animals, tinea capitis of Soudanese. *Ateleothylax Currii* (p. 431).

Central area raised, with about 12 radial furrows; reverse brown, with a 3 mm. red orange ring and margin of immersed hyphae, woolly above. *E. erioton.*

Central area raised, irregular, powdery, with about 24 radial furrows, chalky white with sometimes a feeble rose or lilac tone, disc rarely white, sourrounded by a zone of purplish or greenish yellow. *E. Otae.*

Spirals often present on various media but absent on Sabouraud agar; nodular organs highly developed.

Colonies flat discs with shallow radial furrows, cream yellow, surface suggesting hot curdled milk. On conservation agar, a truncated cone with deep crater of short white velvet and radial furrows. *E. lacticolor.*

Colonies with central umbo with a yellowish brown powdery zone and a tendency to concentric zones, woolly. *E. Nakamurae.*

Spirals on Sabouraud media in pleomorphic mycelium only, nodular organs not reported.

Umbilicate at first, becoming umbonate, white powdery, with long immersed rays forming small powdery islets where they reach the surface; on conservation agar, glabrous, moist, yellow, margin with short radial folds, powdery. *E. farinulentum.*

Not umbilicate at first, with only a slight boss in the center, light cinnamon with a white margin, deepening with age, surface suggesting rough side of a piece of chamois, no folds or furrows, margins uneven. *E. scorteum.*

Spirals on Sabouraud media, easily breaking up into arthrospores and not abundant; closterospores not very abundant, 2-celled; nodular organs not described but perhaps present; central knob surrounded by several zones; white, smooth tobacco-yellow, gray granular (surface of chamois leather) then 5-6 alternating, very narrow, light and dark circles and a white margin. *E. circuluscentricum.*

Spirals on all media, central eminence becoming umbilicate with powdery lanceolate rays (less pronounced in maltose), reverse reddish; on conservation agar, colony resembles lunar craters, irregular powdery. *E. mentagrophytes.*

Morphology unknown.

With very slender rays, yellowish brown, pleomorphism not observed. var. *chibaense.*

With fine radial striations, rose red, becoming reddish brown; reverse rose; on conservation agar short, thick velvet, white. *E. chimeense.*

Without rays; reddish with white downy margin, reverse deep dark brown, pleomorphism in 40 days, medium dark red; on conservation agar, snow white, with thin yellowish center; reverse not colored. *E. Kagawaense.*

Central knob purple lake, covered with a creamy white powder, probably of mouse origin, Australia. *E. rodens.*

Ectotrichophyton granulosum (Sabouraud) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1006, 1919.

Trichophyton granulosum Sabouraud apud Pécus, Rev. Gén. Méd. Vét. **15**: 561-586, *14 figs.,* 1909.

Trichophyton gypseum var. *granulosum* Sabouraud apud Dalla Favera, Ann. Derm. Syphiligr. IV, **10**: 440, 441, 1909.

Trichophyton mentagrophytes var. *granulosum* Neveu-Lemaire, Précis Parasitol. Anim. Domest. 71, 72, 1912.

Sabouraudites (*Aleurocloster*) *granulosus* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Chlamydoaleurosporia granulosa Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 412, 1925.

Producing an epizoötic in horses (first on 800 horses at Sedan), one slight lesion in man. Dalla Favera also reports a case in a human being. Pautrier & Rietman (1922) report an epidemic of 100 cases due to this organism in Strasbourg, but the organism is not carefully described. In 1924 they report a laboratory infection from washing tubes containing year-old cultures. Perhaps their cases should be referred to *E. eriotrephon* or *E. lacticolor.* Easily inoculable into guinea pig. According to various reports, it spread to Germany after the World War, but is apparently dying out in that region. Quite probably these reports should be referred to *E. eriotrephon,* from the descriptions of their organisms. Also reported from Poland, Manchuria, Japan, and São Paulo in Brazil. Neither unnamed variety, described by Ballagi (1926) as belonging to this species, should be referred here.

Chlamydospores present, often several in a dense group, suggesting nodular organs but less highly developed than in *E. lacticolor;* spirals, closterospores 7-8-celled, and racquet mycelium not reported by Sabouraud but found by various authors on other media, especially polysaccharides, often rare; aleurospores typical.

Colony powdery, disc yellowish white, sowed with larger granules. Center with elevated umbilicus or hollow, radial folds sometimes half hooded. On conservation agar, smaller central portion, larger denticulate margin, surface often with drops of water. Very close to *E. mentagrophytes.*

Ectotrichophyton eriotrephon (Papegaaij) Dodge, n. comb.

Trichophyton eriotrephon Papegaaij, Over path. Huidschimmels in Amsterdam 59-65, *Pl. 3,* 1924; Nederl. Tijdschr. Geneesk. **69**: 885, 886, 1925; Acta Dermato-venereol. **7**: 1-6, *Pl. 1,* 1926.

Producing vesicosquamous ringworm on wrist. Not pathogenic for mice, only slightly so for guinea pigs. Holland.

Nodular organs of branched, contorted hyphae, 30-40μ in diameter covered with sterile hyphal tips and containing a deeply staining center with 5-10 bodies suggesting spores. Chlamydospores 6-7.5 × 3-4.5μ, ellipsoid, lateral; aleurospores subspheric, 3-4μ; no closterospores reported.

On Sabouraud maltose or glucose agar, growth rapid, central knob of long velvet becoming crateriform and finally cerebriform and divided into irregular sectors; middle smooth and light yellow green; pleomorphism in 2 weeks, colony becoming yellowish; rose colored pigment diffusing into surrounding medium. On peptone agar, colony remains light gray, becoming cerebriform.

Ectotrichophyton felineum (Blanchard) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1006, 1919.

Trichophyton felineum Blanchard in Bouchard, Traité Path. Gén. **2**: 914, 915, 1896.

Trichophyton pyogène à cultures blanches Sabouraud, Trichophyties humaines, 186, 187, 1894.

Trichophyton niveum Sabouraud [as species group rather than true species], Maladies du cuir chevelu **3**: 374, 1910.

Trichophyton radians Sabouraud, Maladies du cuir chevelu **3**: 374-378, 1910.

Trichophyton niveum var. *radians* Sabouraud, Maladies du cuir chevelu **3**: 338 [footnote], 1910.

Microsporum felineum Neveu-Lemaire, Précis Parasitol. Anim. Domest. 100, 1912 (pro parte, non aliorum).

Microtrichophyton felineum Neveu-Lemaire, Précis Parasitol. Hum. 53, 1921.

Sabouraudites felineus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 327, 1923.

Aleurosporia radians Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Trichophyton (*Aleurosporia*) *radians* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Predominantly producing vesicular inflammation of glabrous skin or even kerions in pruritus ani (DuBois 1923). Easily isolated from serous pus. Inoculable into guinea pig (fide Bruhns & Alexander 1928). Occasional in France, Germany, Switzerland, Austria, Uruguay(?), Japan.

On oats spirals highly developed, on other media with higher carbohydrates less so. Coremia common on cereals, horse dung, and starch + peptone media. Closterospores abundant. Only relatively small chlamydospores on Sabouraud agar, aleurospores caducous and not abundant, sporophores simple.

On Sabouraud glucose or maltose, velvety, center more or less crateriform with long, slender, delicate rays, sometimes flexuous or somewhat interwoven, snow white, no pleomorphism. Sabouraud suggests that this species may be a pleomorphic form of some member of the *T. gypseum* group (e.g., *E. mentagrophytes*) in which the pleomorphic form is so fixed that it is not reversible either in natural or artificial inoculation in animals. While in one case a cat was suspected as being the source, it has not been isolated from domestic animals.

Var. **denticulatum** (Sabouraud) Dodge, n. comb.

Trichophyton niveum var. *denticulatum* Sabouraud, Maladies du cuir chevelu **3**: 338 [footnote], 1910.

Trichophyton denticulatum Sabouraud, Maladies du cuir chevelu **3**: 374-377, 1910.

?Trichophyton candidum endosporum Rosenbach, Über die tiefen eiternden Schimmelerkrankungen der Haut 38, 1894.

Ectotrichophyton (Microtrichophyton) denticulatum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1006, 1919.

Microtrichophyton denticulatum Neveu-Lemaire, Précis Parasitol. Hum. 54, 1921.

Aleurosporia denticulata Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Trichophyton (Aleurosporia) denticulatum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Lesions more inflammatory than in the species. Inoculable into guinea pig where the lesions are similar to those produced by *E. mentagrophytes*.

Colony a circular velvety felt, with fringe of short teeth; snow white, not pleomorphic.

Ectotrichophyton radioplicatum (W. Fischer) Dodge, n. comb.

Trichophyton gypseum radioplicatum W. Fischer, Derm. Woch. **57**: 1402-1406, *1 fig., Pl. 11, Figs. 3-6,* 1913.

Trichophyton radioplicatum Bruhn & Alexander in Jadassohn, Handbuch d. Haut- u. Geschlechtskrankh. **11**: 173, 174, 1928.

Large lesions on lower jaw and neck of coachman, sycosis, infiltrated, with some pus, ectothrix infection of hairs with small spores. Inoculation of guinea pigs successful, spontaneous healing in 3 weeks; ectothrix. Germany.

Spores, racquet mycelium present, spirals of 6-12 turns present, tips of hyphae thickened but no closterospores, chlamydospores in chains, aleurospores abundant, either in simple or compound thyrses. Pleomorphic mycelium with a few spores. Since the morphology was studied several months after isolation, closterospores were probably present at first, becoming degenerate and represented by the clavate hyphal tips, as Grigorakis has shown the gradual disappearance of closterospores following repeated subcultures on artificial media.

Colony light gray, becoming blue gray, center depressed with about 20 flexuous furrows and folds which disappear before the margin is reached. Margin gray white, smooth, without radiations. Pleomorphism in 2 weeks, not starting from center, diameter of 8 cm. in 4 weeks. On conservation agar, center irregularly depressed and fissured, radial folds straight, less numerous and sharp, pure white.

Ectotrichophyton griseum (Fischer) Dodge, n. comb.

Trichophyton griseum F. Fischer, Verh. Berliner Derm. Ges. **1909, 1910**: 112, 1910. Prytek, Arch. Derm. Syphilis **113**: 826, 1912; W. Fischer, Derm. Woch. **57**: 1400-1402, *Pl. 11, Figs. 1* and *2*, 1913; not Vasconcellos, 1914.

From a superficial lesion, 5 × 7 cm., infiltrated, with few scales on the forearm. Inoculation of guinea pig showed severe ectothrix lesion, spontaneous healing in 3 weeks. Original case supposed to have been contracted from dog, not proved. Germany.

Closterospores, many celled, often in chains, terminal and intercalary chlamydospores and aleurospores present but no spirals.

Growth rapid, central white down in 2-3 days, with a surrounding thin white mycelium. The central portion umbilicate, dark brown surrounded by a circular white plateau, which is soon gray green, becoming lighter and taking on a yellowish tone. This in turn is surrounded by a younger gray green zone with an outer zone of white radiations. Pleomorphism in 3 weeks.

Var. **brasiliense**, Dodge, n. var.

Trichophyton griseum Vasconcellos, Mem. Inst. Oswaldo Cruz **6**: 11-17, *Pls. 2, 3,* 1914; not W. Fischer, 1913.

Sabouraudites griseus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Lesion 3 × 4 cm. on forearm, a plateau covered with scales as in lichen planus, grayish yellow, vesicles around margin, scales formed by the rupture of the vesicles. Brazil. Priestley (1917) reports it from a case of onychomycosis in Australia.

Closterospores and aleurospores present.

Colony a flat white velvety disc becoming gray with a white border; in 6 weeks forming concentric zones of depressions and elevations about a center of irregular depressions traversed by elevations, radial furrows sometimes reaching the margin. On Sabouraud glucose agar, same as above, but lighter gray, concentric zones more distinct, central elevation less marked; reverse somewhat violaceous, pigment diffusing into the medium. On Sabouraud conservation agar with 3% peptone, as above, but zones still more marked and no central elevation. On potato, colony gray spreading over surface of medium, rapidly pleomorphic. On carrot, white or light yellow colony, growth rapid and soon pleomorphic. On broth and on glycerol, a pellicle is formed.

Ectotrichophyton multicolor (Magalhães) Dodge, n. comb.

Trichophyton multicolor Magalhães & Neves, Mem. Inst. Oswaldo Cruz **20**: 271-298, *Pls. 45-56,* 1927.

Lesion on the left temporoparietal region of a white male of 10 years, scales not hard, easily detached, covering microvesicles with or without pus; lesion had been pruriginous for 8 months. Experimentally inoculated on a white male (18 years). After 9 days, a small circinate plaque with microvesicles, becoming 3.2 cm. in diameter in 18 days and 5.5 × 6.6 cm. in 32 days, when it was treated and promptly cured by the application of an ointment (chrysarobin 0.3 gm., salicylic acid 0.1 gm., zinc oxide 1 gm., vaseline 5 gm., and lanolin 5 gm.). The lesion had disappeared by the fifty-sixth day.

Mycelium and some aleurospores appear on the seventh day after germination. Thyrses and both terminal and lateral chlamydospores on the eighth day, compound thyrses and varicose hyphae on the ninth day. At one month, closterospores 5-8-celled, 48-70 × 5.5-9μ, mycelium 2-4μ, rarely 6μ in diameter; chlamydospores 10-20μ, aleurospores 4-5μ.

Colony cerebriform, pulverulent, rose color with ochraceous tints toward the center, becoming vinous except in the center which remains ochraceous. On Sabouraud conservation agar, intensely velvety, yellow ochre. On malt agar, yellow ochre, slightly folded. On potato glycerol, growth is poor.

Ectotrichophyton erioton (Cazalbou) Dodge, n. comb.

Trichophyton erioton Cazalbou, Bull. Soc. Centr. Méd. Vét. **91**: 118-120, 1914.

Lesions as in *Megatrichophyton.*

In the scales filaments are 3μ in diameter, septate, also in follicles, arthrospores 3-6μ, polyhedral to spherical. Closterospores present; aleurospores not observed.

On maltose peptone, velvety disc, 5 cm., grayish, woolly, central area slightly raised, about 12 furrows; margin of immersed hyphae; reverse brown with a red orange ring about 3 mm. wide. On glucose, the colony is similar, but furrows fewer, more definite, central dome less developed, reverse uniformly pale yellow. Odor of urine more marked than in *Megatrichophyton equinum.*

Ectotrichophyton Otae Dodge, n. nom.

Sabouraudites ruber var. *blanche* Hashimoto, Irizawa & Ota, Jap. Jour. Derm. Urol. **30**: 1-9 [1, 2], 1930.

Isolated from trichophytic lesions of the glabrous skin and nails. Japan. Inoculable to guinea pig, producing lesions of the *T.* neoendothrix type.

Arthrospores 3-5μ in the hair, reaching 8μ. Closterospores, aleurospores singly and in racemes, but no spirals produced in cultures. Colony a finely felted disc or even powdery with furrows radiating from an elevated irregular plateau covered with velvet, reaching 7-8 cm. in 3 weeks, chalk white, sometimes with a faint rose or lilac tone. On maltose, more pigment production than on glucose, disc sometimes white, surrounded by a zone of purple or greenish yellow.

This variety was thought to be a pleomorphic form of *Epidermophyton rubrum* to which *T. rubidum* of Priestley and *E. lanoroseum* MacCarthy were also referred. A careful reading of the original descriptions shows that this species is quite distinct from both in its cultural characters and its inoculability into guinea pigs, where it produces a wholly different type of lesion. The abundance of closterospores militates against considering it as a pleomorphic strain of some other species. It is reported to be distinguished from *T. coccineum* Kato and *T. lileum* Kawasaki by the presence of closterospores.

Ectotrichophyton lacticolor (Sabouraud) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1006, 1919.

Trichophyton lacticolor Sabouraud, Maladies du cuir chevelu **3**: 362-368, 1910.

?Trichophyton holosericum album Rosenbach, Über die tiefen eiternden Schimmelerkrankungen, der Haut. 27, 1894.

Sabouraudites (*Aleuramma*) *lacticolor* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Chlamydoaleurosporia lacticolor Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 412, 1925.

Trichophyton (*Chlamydoaleurosporia*) *lacticolor* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Trichophyton gypseum var. *lacticolor* Ballagi, Derm. Woch. **83**: 1155-1169, 1926.

Producing multiple kerions of the beard. Easily inoculable to guinea pig. Rare, reported from France, Germany, Sweden, Hungary, New York, São Paulo in Brazil, and Japan.

Aleurospores on long simple sporiferous hyphae, or short and branched hyphae; characteristic nodular organs. On cereal media, spirals abundant, aleurospores as above, but better developed, closterospores abundant on barley. Dimorphism of sporiferous hyphae and sterile hyphae greater, and closterospores present on soluble starch or dextrin with peptone, but no closterospores in the absence of peptone.

Primary cultures flat discs, with shallow radial furrows, cream yellow, surface suggesting hot curdled milk. On conservation media, colony a truncated cone, with radiating furrows and a very deep crater with short white velvet. Pleomorphic colony center slightly elevated, with a comparatively broad irregular crater whose sides are relatively lower as the colony ages; reverse canary yellow.

The nodular organs reach their highest development in this species. These organs develop from rows of cells which resemble a young closterospore, the cells elongate and begin to curve and even coil until a dense mass of large thick-walled chlamydospores is formed. These organs are sometimes sessile, sometimes pedicellate. They are often surrounded by a mass of flexuous hyphae which may be the germ tubes of the chlamydospores germinating *in situ*. Spirals and true closterospores not produced on Sabouraud agar, although present on other media.

Ectotrichophyton Nakamurae Dodge, n. sp.

Microsporon sp. Nakamura, Jap. Jour. Derm. Urol. **31**: 1462-1472, *16 figs.* [152], 1931.

Producing Celsus' kerion on scalp of a boy of 4 years. Japan. Easily inoculable into rabbit and guinea pig.

Arthrospores, nodular organs, aleurospores, chlamydospores, and multilocular closterospores present. No spirals, compound thyrses of aleurospores, nor pectinate organs seen.

Colonies woolly, white, forming a yellowish brown powdery zone around the central umbo, with a tendency to concentric zones. Pleomorphism in 47 days. When the colony is viewed under ultraviolet light, the central portion is reddish brown and the margin an intense violet.

While Nakamura placed this organism in *Microsporum,* reporting it closely related to *M. fulvum,* his description of the lesion with mycelium as well as spores within and without the hair, the abundance of pus in the hair follicles, and the elevated lesion all point to a species of *Ectotrichophyton.* The same conclusion is reached from a study of the morphology of the fungus, where the abundance of nodular organs suggests *Ectotrichophyton,* although they have been reported in *M. fulvum.*

It seems probable that the organism described by Takahashi, Jap. Jour. Derm. Urol. **28**: 542-550, *3 figs.,* 1928 under the name *Trichophyton farinulentum* should be referred here. Takahashi described his organism as follows:

Producing tinea capitis profunda in Japan. Pathogenic to guinea pigs.

Closterospores and terminal and intercalary chlamydospores present, also aleurospores.

In the incubator, colonies moist, elevated, brown, with deep radial furrows and a few pointed coremia in the center. Subcultures white, powdery, with short radial folds and knob in center, later greenish yellow, brownish or red brownish, becoming pleomorphic.

Ectotrichophyton farinulentum (Sabouraud) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1005, 1919.

Trichophyton sp. Sabouraud, Trichophyties humaines 114, *Fig. 117,* 1893.

?Trichophyton propellens leptum Rosenbach, Über die tiefen eiternden Schimmelerkrankungen der Haut 39, 1894.

Trichophyton farinulentum Sabouraud, Maladies du cuir chevelu **3**: 368-370, 1910.

Sabouraudites farinulentus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 327, 1923.

Closteroaleurosporia farinulenta Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (*Closteroaleurosporia*) *farinulentum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing kerions on both children and adults, much more severe on the scalp than on the glabrous skin. Probably of animal origin but not proved. Inoculable to guinea pig. Occasionally found in France and in Montreal, Canada.

Closterospores and aleurospores abundant, spirals only in the pleomorphic mycelium where they are somewhat more slender and flatter than is usual in this group.

Colony a white powdery disc, umbilicate, with radial furrows, later the center becomes umbonate, margin of immersed rays, more pronounced on glucose where it is separated from the rest of the colony by a glabrous zone. Pleomorphism in 3 weeks; the subcultures still have a suggestion of the form of the original colony, but are much more irregular. On Sabouraud conservation agar, glabrous, yellow, moist, no velvet, at first a flattened cupola, periphery cut by radial folds which increase in number as the colony ages, margin becomes powdery, center with tufts of short yellow hyphae.

Ectotrichophyton scorteum (Priestley) Dodge, n. comb.

Microsporum scorteum Priestley, Ann. Trop. Med. Parasitol. **8**: 113-118, *Pl. 7,* 1914.

Sabouraudites scorteus Brumpt, Précis Parasitol. ed. 4, 1295, 1927.

Producing inflamed areas of the calf in a 15-year-old boy, no scaliness; hairs appeared normal to the naked eye, slight pruritus, lesions disappeared in about a month after scrubbing with soap and water. The description of the original lesion suggests *Ectotrichophyton* rather than *Microsporum.*

On hairs, very little mycelium and few spores. In cultures, closterospores 2-5 septate, 35-60 × 11-14μ, singly or in terminal groups of 6-8, smooth, ends without spines; aleurospores scanty, 3-4 × 2-3μ, no compound thyrses; chlamydospores rare; nodular organs present; spirals in pleomorphic mycelium, not in the primary mycelium, somewhat irregular and flattened; pectinate hyphae rare.

Growth rapid (1 cm. in 2 days) whitish at first, fluffy on fifth day, light cinnamon with white margin, suggesting the rough side of a piece of chamois, margins uneven, surface rough without folds, slight boss in center; color deepening gradually; pleomorphism after 2 months. On nutrient agar, growth slow, roughness less marked, almost white. On nutrient broth, growth rapid on surface, deep cinnamon, folded. No acid or gas produced from sugars. Milk slowly digested without previous clotting.

Priestley considered this species close to *M. fulvum,* but the morphologic and cultural characters seem to be more typical of *Ectotrichophyton.* Apparently the species is very close to *E. farinulentum,* but is less virulent and differs in cultural characters.

Ectotrichophyton circuluscentricum (Magalhães) Dodge, n. comb.

Microsporum circuluscentricum Magalhães, C. R. Soc. Biol. **90**: 53-55, 1924; Mem. Inst. Oswaldo Cruz **21**: 173-188, *Pls. 18-23,* 1928.

Isolated from a case of tinea capitis, ectothrix type on a child of 16 months in Brazil.

Closterospores very rare, only 2-celled, 23 × 7μ; terminal and lateral chlamydospores 10.5μ; thyrses of conidia 3.5μ, mycelium 2.3μ; a few spirals present, readily breaking up into arthrospores. [The crude figures suggest the beginning of a sexual act.]

The central knob white, downy, projecting 3 mm. in diameter; next a white zone 3-5 mm., a smooth tobacco (Havana)-yellow zone 5 mm., a gray zone with the appearance of chamois leather with 5-6 concentric, very narrow circles and a margin of pure white radiating hyphae; 7-8 radial furrows. Colony essentially similar on other media.

Magalhães considered this species close to *Microsporum fulvum*, but its morphology suggests *Ectotrichophyton*.

Ectotrichophyton mentagrophytes (Robin) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1005, 1919.

Mentagrophytes Gruby, C. R. Acad. Sci. **15**: 512, 513, 1842.

Microsporon mentagrophytes Robin, Hist. Nat. Vég. Paras. qui croissent sur l'homme. . . Anim. 430-436, 1853.

Sporotrichum (*Microsporum*) *mentagrophytes* Saccardo, Syll. Fung. **4**: 100, 1886.

Trichophyton megalosporon pyogène du cheval Sabouraud, Ann. Inst. Pasteur **7**: 497-528, *Pls. 6, 7,* 1893.

Trichophyton farinaceum album polysporum Rosenbach, Über die tiefen eiternden Schimmelerkrankungen der Haut 36, 1894.

Trichophyton du cheval à cultures blanches Bodin, Teignes tondantes du cheval 66-83, 1896.

Trichophyton mentagrophytes Gedoelst, Champ. Paras. Homme 86, 87, 1902.

Trichophyton gypseum Bodin, Champ. Paras. Homme 115-118, 1902.

Trichophyton asteroides Sabouraud, Maladies du cuir chevelu **3**: 347, 1910.

Trichophyton mentagrophytes var. *asteroides* Neveu-Lemaire, Précis Parasitol. Anim. Domest. 69-71, 1912.

Trichophyton gypseum var. *asteroides* Auct.

Sabouraudites asteroides Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 327, 1923.

Aleurosporia rosacea Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Microsporum (*Closterosporia*) *asteroides* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Ctenomyces mentagrophytes Langeron & Milochevitch, Ann. Parasitol. Hum. Comp. **8**: 484, 1930.

Spiralia mentagrophytes Grigorakis, C. R. Soc. Biol. **109**: 186-188, 1932.

Isolated from kerions of glabrous skin and beard. Found on the horse and inoculable into the guinea pig and *Silenus rhesus* (Ashford, McKinley & Dowling 1930). Common in France, Germany, and Hungary, occasionally found in São Paulo in Brazil, Uruguay, Tomsk in Siberia, and Japan, among agricultural laborers. Parish & Craddock (1931) describe an epidemic among laboratory workers, contracted from mice.

Closterospores 3-5-celled, cells easily separating before germination; chlamydospores 4-5μ, not numerous; aleurospores 2-3μ in diameter; borne in large compound thyrses, spirals abundant, of 12 or more turns, characteristically formed following hyphal anastomoses.

Growth rapid (10 cm. in 6 weeks), central dome cut by deep furrows, lanceolate rays rudimentary, disc white, powdery; on Sabouraud glucose agar, center round, elevated, with powdery rays, then umbilicate with lanceolate rays which increase in number, covered with white powder where they reach the surface of the medium. Pleomorphism in 4-5 weeks; reverse reddish. On Sabouraud conservation agar, the colony resembles lunar craters, somewhat irregular, covered with the same floury powder as on carbohydrate media but less abundantly. Pleomorphic colony a disc of velvet, sometimes umbilicate at the center. First subcultures of pleomorphic mycelium yield colonies intermediate between the typical primary colony and the pleomorphic colony, but successive subcultures yield colonies increasingly like the typical pleomorphic colony, finally becoming a completely sterile mycelium. On potato, a thick whitish streak, slightly velvety.

Langeron & Milochevitch would reduce *Ectotrichophyton radiolatum, E. granulosum,* and *Epidermophyton interdigitale* to synonyms with this species. Since their microscopic characters are close, they are conceived as being heterothallic strains of this species.

Var. **radiolatum** (Bruhns & Alexander) Dodge, n. comb.

Trichophyton gypseum var. *radiolatum* Bruhns & Alexander in Jadassohn, Handbuch d. Haut- u. Geschlechtskrankh. **11**: 175, 176, 1928.

Trichophyton radiolatum Sabouraud, Maladies du cuir chevelu **3**: 355, 356, 617-621, 1910.

Ectotrichophyton (*Microtrichophyton*) *radiolatum* Castellani & Chalmers, Man. Trop. Med. ed. 3, 1006, 1919.

Sabouraudites radiolatus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Microsporum (*Closterosporia*) *radiolatum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

? Cercosporella vexans Massee apud Russ, Lancet **204**: 77, 78, *2 figs.*, 1923.

Producing kerions and vesicopustular lesions in man. Easily inoculable into guinea pig and rabbit, producing ectothrix type of lesions which healed spontaneously in about 6 weeks (Catanei 1933). Rare, but recently showing increase of frequency in Schlesien, Germany.

Microscopically as in *T. mentagrophytes.* Tips of hyphae often show clavate enlargements as in *Microsporum.*

At first colonies similar to those of *E. mentagrophytes,* white, less pure, somewhat rose color. On maltose agar, center more regularly rounded. On glucose agar, rays less sword-shaped and more confused. Pleomorphism in 3-4 weeks, colony with shallow radial furrows while none in *E. mentagrophytes.* [Further cultural notes on various media by Catanei, 1928.] On coagulated serum, colonies whitish, moist, smooth, except for margin which is chalky and bears the aleurospores. Catanei (1933) reports three types of pleomorphic colonies: the usual type with a crateriform center which develops radial furrows, finally becoming almost cerebriform, with fewer aleurospores, so that the colony is less powdery; a type with a more persistent central crater which is often tinged yellowish; and a third type with a golden yellow or orange central knob from which radiate short furrows.

Var. **chibaense** (Ogata) Dodge, n. comb.

Sabouraudites asteroides, var. *chibaense,* Ogata, Jap. Jour. Derm. Urol. **29**: 1183-1232, *Pl. 41, 25 figs.,* 1929.

Trichophyton gypseum asteroides, var. *chibaense,* Ogata, Jap. Jour. Derm. Urol. **29**: 1183-1232, *Pl. 41, 25 figs.,* 1929.

Maculovesiculose ringworm pruritus on glabrous skin of trunk and arms. Typically endothrix, spores 2-2.5μ in scales. Easily inoculable into guinea pig, rabbit, cat, or dog. Lesion reproduced in man, producing kerion in the scalp.

Hyphae 3-4μ, aleurospores 3μ, ovoid, in compound thyrses, spirals present. Closterospores probably present, but not mentioned by Ogata.

Growth rapid, 5 cm. in 2 weeks. Center knotted, dry, yellowish brown, with fine powdery velvet and slender radiations. On glucose agar, brownish yellow without powder. On koji agar, fine radiations with powder from center to periphery. On Pollacci agar, growth good, brownish yellow, membranous, center crateriform, periphery much folded, surface dry with fine white powder. Pleomorphism not observed.

Fujii, 1930, reports that an old culture which ceased to produce closterospores, did so again after transfer to Pollacci agar.

Ectotrichophyton ehimeense (Fujii) Dodge, n. comb.

Trichophyton ehimeense Fujii, Jap. Jour. Derm. Urol. **31**: 305-357, *Pls. 25, 26,* 1931.

Tinea tonsurans ectothrix type but spore sheath not conspicuous. Spores 3μ in hair and in scales. On guinea pig producing papules, typically ectothrix.

Hyphae 4μ; aleurospores, on simple thyrses, 3μ; chlamydospores 9μ. Closterospores 1, rarely 2 celled, 13 × 4μ, pectinate organs and spirals present.

Growth slow, size of pea in 2 weeks, white downy, elevated at first, gradually becoming rose red and velvet disappearing; center umbilicate, with many very fine radial striations, reddish brown. Medium rose color. On peptone agar, 1 cm. in 30 days, with short thick velvet. No coloring of medium or colony.

Ectotrichophyton Kagawaense (Fujii) Dodge, n. comb.

Trichophyton Kagawaense Fujii, Jap. Jour. Derm. Urol. **31**: 305-357, *Pls. 25, 26,* 1931.

Lesions on back of hand, margin of scales reddish, center healing; no vesicles, slight pruritus. In scales, hyphae 5μ, arthrospores 5.5μ. Inoculable to guinea pig, rabbit, and man. In guinea pig, slight scaling, ectothrix type. Reported endothrix in experimental lesions in scalp.

Hyphae 4.8μ, aleurospores 4.5-5.5μ, mostly on simple thyrses, a few compound. Chlamydospores spherical, 8-10μ, intercalary. Spirals and pectinate organs present.

Growth rapid, 5 cm. in 3 weeks, white downy, smooth, and hemispheric at first, center becoming umbilicate, elevated, 1.5 cm., with a thin reddish velvet; margin white and downy; reverse deep dark brown. Pleomorphism in 40 days, medium dark red. On peptone agar (24 days), colony 1.5-2.0 cm., snow white down and thin yellowish center; reverse not colored.

Species of Doubtful Position

Trichophyton rodens Paul, Med. Jour. Australia **4**: 2: 496, 497, *3 figs.*, 1917.

Lesions in men who had been handling wheat infested with mice, which were partially denuded of hair. Eruptions on exposed parts and numerous and extensive areas of pustulation (multiple kerion) on the hairy portions of the face. At first it resembles goose-skin without redness, later with erythema and pruritus, especially at night. The early lesions have rounded and sharply circumscribed borders in which are scattered discrete vesicles, vesicopustules, and pustules on an erythematous base; desquamation absent. Later the vesicles and pustules disappear and papules or papulovesicles appear with a surface of dry scaly roughness as in chronic eczema.

Colony a slightly raised central knob, purple lake, covered with a creamy white powder on the tenth day; pleomorphism in a few weeks.

While this species is too briefly described to place definitely, its lesions and general habit and probable animal origin seem to place it in *Ectotrichophyton.* Its colony characters should make it recognizable if encountered again.

Trichophyton depressum MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 184-190, *Pl. 1, 3 figs.*, 1925.

Intense pruritus between the shoulder blades of an Italian cook in France. Lesions showed an elevated border with a few vesicles, covered with fine brownish scales.

Only aleurospores, 3-4μ or smaller, borne on either simple or compound thyrses reported. Cultivated only on Sabouraud agars.

Center depressed with irregular, ill-defined borders, bottom of the crater furrowed, cream color; margin snow white, powdery and velvety; no trace of pleomorphism. On Sabouraud conservation agar, growth slower but more characteristic. On fortieth day, colony 2.5 cm. in diameter, center yellowish gray with spots of short white velvet, depressed in the center with irregular furrows, subcerebriform; surrounded by whiter zone with about 16 radial furrows; margin narrow, ashy.

Achorion Arloini Busquet, Thèse, Lyon 1890; Ann. Micrographie **3**: 9-21, 62-76, 136-149, *Pls. 2-4,* 1891.

Aleurisma Arloingi Vuillemin apud Massia & Grigorakis, C. R. Soc. Biol. **91**: 1381, 1382, 1924.

Case history by Désir de Fortunet, Lyon Méd. **62**: 253-256, 1889; Désir de Fortunet & Courmont, Ann. Derm. Syphiligr. III **1**: 239-242, 1890. Circinate vesiculosquamous lesions of the hand, producing favic scutula on mouse similar to *A. muris.* Not inoculable to calf, squamous lesion on rabbit.

Aleurospores spherical or ovoid, thick-walled; chlamydospores present. Closterospores 5-7-celled.

On veal broth, producing superficial white islands with lower surface bright red after tenth day. On potato, an irregular, furrowed, white colony slightly velvety margin, powdery and yellowish at the center, medium blackening. Gelatin liquefied, colony similar to those on liquid media but reverse white; on Nöggerath's gelatin, colony greenish yellow, reverse black; on cabbage stalks colony red under white velvet.

Without giving cultural details, Massia & Grigorakis report that it colors certain media bright red and that its aleurospores are 3-4 × 2-2.5μ.

This species has been inadequately described so that its systematic position is uncertain. Bodin and Sabouraud concluded that it belonged in the genus *Trichophyton* near *T. gypseum* (here treated as *Ectotrichophyton mentagrophytes*). The lesion and some of the cultural characters suggest *Epidermophyton purpureum,* while lesions on experimental animals suggest *Achorion muris.*

Aleurisma Guilliermondi Grigorakis, C. R. Soc. Biol. **87**: 492, 493, 1927.

Isolated from sycosis from two brothers in Lyon.

Aleurospores 2-3.5μ, occasionally chlamydospores present. Germination with 3-5 germ tubes. Very rarely arthrospores. Pigment in granules about the vacuoles, not soluble in ether or chloroform.

Colonies sulphur colored (pigment more abundant in colonies developing in the dark). Yellow on malt gelatin, liquefied.

Too briefly described to place definitely, temporarily placed here on the basis of the lesions produced.

Trichophyton chosenicum Takahashi, Jap. Jour. Derm. Urol. **25**: 285, 286, 1925.

Grubyella chosenica Takahashi, Jap. Jour. Derm. Urol. **25**: 284, 1925.

Originally isolated from tinea interdigitalis between toes of a soldier, Korea. Inoculable into man and experimental animals, in the latter producing the ectothrix type of lesion.

Hyphae 2μ in diameter, intercalary and terminal chlamydospores in old cultures with yellow pigment granules; aleurospores rare, spherical, 1-2μ in diameter.

Colony white, powdery, hemispheric, yellowing in 10 days, becoming crateriform; yellow pigment turning deep red on treatment with alkali.

The English résumé is too brief for definite placing of this species. Its author evidently thought it belonged in *Favotrichophyton* or *Achorion.* The human lesion suggests *Epidermophyton,* while the lesion in experimental animals suggests *Ectotrichophyton* or *Microsporum.* (Cf. *M. ferrugineum.*)

Trichophyton sp. Ceresole, Ann. Derm. Syphiligr. IV, **7**: 743-750, 1906.

MEGATRICHOPHYTON

Megatrichophyton Neveu-Lemaire, Précis Parasitol. Hum. 54, 1921.

Ectotrichophyton sect. *Euectotrichophyton* Castellani & Chalmers, Man. Trop. Med. ed. 3, 1007, 1919.

The type species is *Megatrichophyton roseum* (Bodin) Neveu-Lemaire (*T. rosaceum* Sabouraud).

Only chlamydospores and simple thyrses bearing aleurospores present, arthrospores on the hair large; lesions usually confined to the beard, dry, suggesting pilar ichthyosis; on domestic animals, it produces a dry squamous lesion in which the large scale peels off taking the infected hair with it and leaving a grayish denuded area. Rarely, on man, the lesions are accompanied by inflammation.

Key to Megatrichophyton

Reverse yellow, colony white; on conservation agar, center yellow orange, glabrous, folded, center depressed. *M. caninum.*

Reverse yellow, then mahogany red, diffusing; colony white. *M. equinum.*

Reverse brick red; colony powdery white with central knob; reverse not colored on glucose. *M. nodoformans.*

Reverse gooseberry violet, colony pale rose; on conservation agar, reverse black, colony white; pleomorphic colony with central boss and five petaliform sectors. *M. roseum.*

Reverse not colored, colony with slightly acuminate wine red center, flat white border. *M. roseum* var. *vinosum.*

Megatrichophyton caninum (Matruchot & Dassonville) Dodge, n. comb.

Trichophyton caninum Matruchot & Dassonville, Bull. Soc. Centrale Méd. Vét. **56**: 50-71, 1902.

Sabouraudites caninus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 327, 1923.

Causes folliculitis depilans in dog, apparently ectothrix. Inoculable to dog and guinea pig. Not reported since the original case in France.

On Sabouraud glucose, colony floccose, snow white, medium colored yellow; on Sabouraud conservation agar, growth slower, yellow orange at center, glabrous, folded, center depressed. On potato, growth still slower producing a yellow pigment which diffuses into medium. On carrot and squash, colony velvety and less colored.

As there is still some doubt whether this species represents the imperfect stage of *Gymnoascus setosus,* it has been treated separately here. The perithecia attributed to this species by Sabouraud (1910, p. 643) are those which Matruchot & Dassonville later described as *Eidamella spinosa,* a synonym of *G. setosus.*

Megatrichophyton equinum (Gedoelst) Neveu-Lemaire, Précis Parasitol. Hum. 54, 1921.

Trichophyton sp. Matruchot & Dassonville, C. R. Acad. Sci. Paris **127**: 279-281, 1898; C. R. Ass. Franc. Av. Sci. Notes et Mém. **1898**: 449-455, 1899.

Trichophyton equinum Gedoelst, Champ. Paras. Homme 88, 89, 1902; Guéguen, Champ. Paras. Homme 140, 1904.

Ectotrichophyton equinum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1007, 1919.

Probably not *Trichophyton depilans* Mégnin, Arch. Gén. Méd. **141**: 294-304, 1879; Weber & Mégnin, Bull. Soc. Centrale Méd. Vét. 1247-1250, 1882, nor *T. flavum* Sabouraud ap. Bodin nor *T. cerebriforme* Sabouraud, 1910.

Isolated from lesions on horse and man. Skin roughened, soon peeling off a large area of epidermis, taking all the infected hairs with it, leaving a glabrous, moist, rose-colored surface which becomes grayish. As the spot dries, it becomes furfuraceous or powdery and deep bluish gray. In spontaneous lesions in man, central zone pale rose, transversally striate, surrounded by a red ring about 3 mm. wide, scarcely scaly, then a whitish zone, somewhat crustose from the remains of small vesicles, and a margin of small yellowish vesicles, the size of a pinhead and slightly elevated. Twice isolated from the beard, where it was producing kerion. Also inoculable into guinea pig. Occasional in France, rare in Germany, Hungary, Minas Geraes in Brazil, and Uruguay.

Arthrospores in hair 4-6 × 2-4μ. Mycelium abundant, 2-3μ, branching at right angles; aleurospores 2-3 × 3-4μ, ovoid, pedicellate solitary; chlamydospores variable, 3-10 × 2-3μ; spirals well developed on cereal media (Lebasque, 1934).

Colony white, floccose, circular; reverse yellow then mahogany red, pigment diffusing into the medium. On carrot slice, mycelium less abundant, less floccose, sometimes light rose, becoming yellowish in the moister regions of the culture. On potato, growth slow, producing abundant yellow pigment with gradual adaptation to the medium until good growth occurs. On horse dung, growth poor. On cereals, growth cottony, white becoming yellowish and powdery in age.

Megatrichophyton roseum (Bodin) Dodge, n. comb.

Trichophyton roseum Bodin, Champ. Paras. Homme 120, 121, 1902.

Trichophyton à culture rose Sabouraud, Ann. Derm. Syphiligr. III, **4**: 833, 1893.

Trichophyton rosaceum Sabouraud, Arch. Méd. Exp. Anat. Path. **21**: 274-298, 1909.

Ectotrichophyton (*Euectotrichophyton*) *Megnini* Castellani & Chalmers, Man. Trop. Med. ed. 3, 1007, 1919 not *T. Megnini* Blanchard, which is a synonym of *Achorion gallinae*.

Megatrichophyton Megnini Neveu-Lemaire, Précis Parasitol. Hum. 54, 1921.

Aleurosporia rosacea Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Trichophyton (*Aleurosporia*) *rosaceum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Lesions may be either in epidermis or hair follicles, usually of beard and without inflammation. Inoculable to guinea pig. Common in north of England, where it seems to be spread in barber shops rather than by animals.

Also endemic in France, Belgium, Netherlands, Denmark, since the war becoming endemic in Germany, occasional in Italy, Montreal, and Philadelphia, rare in Japan and São Paulo in Brazil.

Colonies snow white when young and velvety, then gradually turning pale rose (color of peach blossoms) while the reverse becomes gooseberry violet; divided into sectors, each becoming elevated and rounded. Pleomorphic velvet starting as crescent or ring at margin, wholly white, surface plane, cut by narrow radial furrows. On Sabouraud conservation agar, primary colony as on sugar media but pure white, reverse black. Pleomorphic colony on this medium elevated with central boss and five petaliform sectors separated by broad and deep furrows.

Var. **vinosum** (Sabouraud) Dodge, n. comb.

Trichophyton vinosum Sabouraud, Maladies de cuir chevelu **3**: 386-388, 1910.

Ectotrichophyton vinosum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1007, 1919.

Megatrichophyton vinosum Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Producing circinate lesions on the face. France.

Suggestive of *M. roseum,* but the pale rose soon becomes wine red. Colony at first slightly acuminate, umbonate at the center, radiate with a flat white border, becoming flatter in age, never presenting the roundness of *M. roseum,* reverse not colored. In 2 months, colony larger than *M. roseum* ever becomes, with a double white border around a wine red powdery center.

Doubtful Species

Megatrichophyton nodoformans (Castellani) Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Trichophyton nodoformans Castellani, Proc. R. Soc. Med. **6**: Derm. Sect. 35, 1912.

Ectotrichophyton nodoformans Castellani & Chalmers, Man. Trop. Med. ed. 3, 1007, 1008, 1919.

Producing tinea cruris, with thick elevated margins and deep-seated nodules along the edge, resembling blind boils. Pyogenic, also attacking the hair follicles. Ceylon.

Colony powdery white, with central knob; the growth slowly deepens in the medium and the submerged portion has a characteristic brick-red color which generally disappears after repeated transplantations. On glucose agar, growth somewhat more abundant and the brick red pigmentation of the submerged growth is usually absent. On glycerol agar, growth quite abundant but no pigment. On ordinary agar, growth scanty, whitish.

Morphology not described, hence the position of this species is doubtful. There seems to be little to distinguish it from *Epidermophyton salmoneum* Froilano de Mello (see p. 484) except the statement that it may attack the hair. However, since I have not had an opportunity to study a similar case or to study authentic cultures, I have preferred not to reduce *E. salmoneum* to synonymy nor to transfer this species to *Epidermophyton*. The original descriptions of both species are lacking in data essential to a proper placing of the organisms.

FAVOTRICHOPHYTON

Favotrichophyton Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Favotrichophyton (as subgenus of *Ectotrichophyton*) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1003, 1919.

Bodinia Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Grubyella Ota & Langeron (*pro parte*), Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Type Species: *Favotrichophyton ochraceum* (Sabouraud) Neveu-Lemaire.

Chlamydospores, aleurospores, and arthrospores present; giant colony usually elevated, convoluted, moist, glabrous and yeastlike or finally covered with a scant velvet, growth circumscribed, similar to *Achorion* in appearance; lesions predominantly in domestic animals, dry crusts covering vesicopustules, causing suppuration and even kerion formation in man; in the subgenus *Bodinia* where the lesions are confined to man, lesions are milder, producing tinea tonsurans of the *Sabouraudia* type, but usually with some inflammation or even suppuration.

This genus may be divided into two subgenera; *Eufavotrichophyton* typified by *F. ochraceum* and *Bodinia* typified by *F. violaceum* (*T. violaceum* Bodin). It is possible that as more information is available about this group it will seem advisable to recognize *Bodinia* as a separate genus on account of the different type of lesion produced, but, so far as data are now available, the morphology of the fungus in culture, and the type of giant colony seem to be very close to those of *Favotrichophyton*.

Eufavotrichophyton is composed of two groups, a group with white colonies which may have been derived from the *Ectotrichophyton farinulentum* line and the main yellow or ochraceous group which may have been derived from the *Ectotrichophyton lacticolor* group.

Recently Baudet (1932) has studied several strains of the white group without identifying his organisms. Perhaps his strain on horses belongs to *F. discoides* and his strains on cows and goats belong to *F. album* and *F. singulare*. Following a suggestion contained in the work of Catanei (1929) on the growth of *Achorion Schoenleini* in the presence of *Staphylococcus* sp. and the products of its metabolism, he found a medium of killed staphylococci very suitable for cultivation, giving much more luxuriant colonies with abundant aleurospores. These spores were also produced in cultures on potato and carrot. Several strains produced some yellow pigment on potato, especially on subculture on this medium. The staphylococcus medium did not affect the morphology of *Favotrichophyton violaceum*.

This genus is of interest from the extreme host specialization of most of its members. Very few species are normally found on hosts from more than one family of mammals and produce more or less evanescent lesions on inoculation into other hosts.

Key to Species

- Colony white or whitish, rarely slightly yellowish or brownish (in *F. discoides*).
  - Colony circular, elevated, disc with central umbo, glabrous, sometimes with a tuft of large hyphae or even covered with short hyphae, brownish neutral or humid and pale yellowish; on man, inoculable to donkey. *F. discoides*
  - Colony waxy, surface vermiculate, umbilicate, with short radial furrows around margin, growth very slow; on Bovidae, western Europe. *F. album.*
  - Colony small globular masses, smooth and vaguely convoluted, becoming a round, velvety disc with a small central hill with 10 deep radial furrows and several shallow ones; after pleomorphism, four concentric ridges and 12 radial ones give the appearance of a spider web, closterospores very rare; on Bovidae, western Europe. *F. singulare.*
  - Colony hemispheric, acuminate, margin with radial folds, growth slow, velvet short; chains of arthrospores suggesting closterospores and favic candelabra present; on Bovidae, Cameroun. *F. camerounense.*
  - Colony conic, spirally furrowed as a snail shell, with a short white velvet; on dromedary. *F. Langeroni.*
  - Colony with cerebriform or folded center, dry, white, margin broad and flat without furrows, closterospores 2-7-celled; on man, Mexico. *F. Urenae.*
  - Colony white, floccose, spreading; on man, Eritrea. *F. abyssinicum.*
- Colony some shade of yellow, ochraceous or brown, at least when young on Sabouraud media.
  - Citron yellow, flat convolutions sunk in agar suggesting petals of flower with wide velvety margin; on bull, France. *F. floreale.*
  - Inner disc elevated, creamy yellow, outer white, in subcultures central plateau green, outer zone cream yellow; human kerions, Brazil (or Portugal). *F. flavivirens.*
  - Yellowish white central boss with many short radial furrows, nodular organs present; pseudopityriasis capitis, Macedonia. *F. balcaneum.*
  - Yellowish or yellowish gray, mostly on Bovidae; colony vermiculate, moist, surface slightly powdery, margin of short velvet; human kerions, Algeria, inoculable into guinea pig. *F. luxurians.*
    - Colony elevated, folded, contorted, color of virgin wax; bulls, north France. *F. ceroton.*
    - Colony bright orange, tuberculiform becoming cerebriform, grayish blue ashy with a white floccose margin; cattle, France. *F. cinereum.*
    - Colony large cerebriform, much folded central mass and a yellowish gray smooth border under the surface of the medium; bulls, France. *F. expansum.*
    - Colony elevated, crater with folded edges, eccentric with white border about the base; not inoculable into guinea pig; cattle, France. *F. coronatum.*
    - Small central dome, margins of short crowded rays; becoming violaceous brown to brownish yellow on glucose; finally velvety and finely wrinkled with small irregular furrows; on sheep, Algeria. *F. pruinosum.*

Ochraceous or darker, at least on Sabouraud maltose, never violet or reddish.

Tubercular, conic base 1-2 cm., tip irregular, obtuse, 5-8 mm. above medium, bright yellow on Sabouraud glucose medium, variously channeled, margin velvety; on horse, France. *F. conicum.*

Small ochraceous tubercles, with sulphur yellow border, covered with short velvet in age; on conservation agar, rounded cerebriform yellowish gray mass; human, probably of bovine origin. *F. ochraceum.*

Small brown cerebriform colonies on Sabouraud agar; small grayish, isolated colonies on potato; on horse. *F. caballinum.*

Colony pale brown, flat with large thick papilla in center, center may remain flat and be surrounded by a ring of papillae; tinea capitis, not inoculable to guinea pig. *F. glabrum.*

Colony some shade of purple, violet or maroon, often brown or yellowish gray in age or in subcultures; predominantly human cases of endothrix type.

Colony moist shining brown, center with fine spines; after a few weeks a narrow violet border appears. *F. violaceum* var. *marginatum.*

Colony rounded with knob in the center, violet with 5-6 radial folds.

Pigment diffusing into medium, scarlet red, no sign of inflammation in lesions. *F. violaceum* var. *khartoumense.*

Pigment not diffusing, usually with some inflammation. *F. violaceum.*

Colony similar but scarlet red, blood red marginal strands; not inoculable to experimental animals. *F. violaceum* var. *coccinatum.*

Colony with prominent, more or less cerebriform center with many regular radial furrows, violet; inoculable to guinea pig. *F. Gourvili.*

Colony dark maroon, surface of small glabrous nodules, finally covered with whitish powdery lanugo. *F. spadix.*

Colony dark brownish purple developing powdery velvet, margin cream color. *F. coccineum.*

Colony irregular, not elevated, with a slight boss, avellaneous, margin of thick, branched, submersed rays, powdery where they reach the surface. *F. avellaneum.*

Colony gray or blue gray; growth very poor on sugar media, forming an immersed disc, 2 cm. in diameter, with only a small blue gray knob above the surface of the medium; on conservation agar irregular, verrucose, grayish with submerged mycelium; on donkey, France. *F. verrucosum.*

Colony greenish black, margin grayish white; growth very slow, center folded and knotted; pigment diffusing into medium, coloring it blackish green; on man, Japan. *F. fuligineum.*

Favotrichophyton discoides (Sabouraud) Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Trichophyton discoides Sabouraud, Maladies du cuir chevelu **3**: 408-412, 1910; Chalmers & Macdonald, Jour. Trop. Med. Hyg. **18**: 49-55, 1915.

Ectotrichophyton (*Favotrichophyton*) *discoides* Castellani and Chalmers, Man. Trop. Med. ed. 3, 1004, 1919.

Grubyella discoides Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Caused tinea barbae with kerions in first case, lesions suggesting eczema seborrhoicum, on forearm without great intensity, cured easily. Inoculable to donkey, not to bull or monkey (Chalmers & Macdonald 1915).

Cultural characters close to *F. album*, but colony more circular, elevated disc with central umbo, brownish neutral color, surface smooth and humid, occasionally with a tuft of large hyphae on the disc and the disc even covered with a short velvet, but it usually remains glabrous, humid, and pale yellowish.

Favotrichophyton album (Sabouraud) Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Trichophyton album Sabouraud, Ann. Derm. Syphiligr. IV, **9**: 617-627, *Pl. 2, 14 figs.*, 1908.

Ectotrichophyton (*Favotrichophyton*) *album* Castellani & Chalmers, Man. Trop. Med. ed. 3, 1004, 1919.

Grubyella alba Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Arthrosporia alba Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 414, 1925.

Achorion (*Bodinia*) *album* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Lesions strictly endothrix in calf, ectoendothrix when inoculated into cow and guinea pig, France; also reported as causing an epizoötic of 80 cases in Minas Geraes in Brazil. On man producing lesions suggesting those of pityriasis rosea but more inflammatory.

Mycelium and chlamydospores regularly present.

Colony waxy, cream color (*cire de cierge*) surface spongy and vermiculate, umbilicate, margins quite regularly folded, growth slow.

Favotrichophyton singulare (Cazalbou) Dodge, n. comb.

Trichophyton singulare Cazalbou, Rev. Gén. Méd. Vét. **24**: 9-11, 1914.

Trichophyton album Baudet, Ann. Parasitol. Hum. Comp. **8**: 512-519, 1930. not Sabouraud 1908.

From lesions on two cows from Nantes, France.

Baudet reports aleurospores, pectinate hyphae, and intercalary or terminal, pedicellate chlamydospores present; in one culture on barley, closterospores were produced.

Primary cultures faviform, small globular masses, glabrous and vaguely convoluted. Then the culture spreads out into a round, white velvety disc with a small central button; in subcultures, cream white, with deep circular furrow around central hill, about 10 deep radial furrows and several other shallow ones, the latter much more irregular. On glucose, aspect similar but colony whiter. After pleomorphism about four concentric circular ridges and 12 radiating ones, suggesting a coarse spider web. Often, however, pleomorphism does not occur, and after about a month the velvet disappears and the colony returns to its faviform appearance.

Baudet's *T. album* is referred here on account of the morphology of the giant colony which differs in several respects from *T. album* Sabouraud.

Favotrichophyton camerounense (Ota & Gaillard) Dodge, n. comb.

Grubyella camerounensis Ota & Gaillard, Ann. Parasitol. Hum. Comp. **4**: 14-21, *Figs. 1-3,* 1926.

Trichophyton papillosum Lebasque, Thèse Sci. Nat. Univ. Paris 71-77, *Pl. 5, Figs. 1, 2,* 1933.

Isolated from lesions on a bull from Cameroun, which had been sent to Paris for experimental work on piroplasmosis. The encrusted areas were about 4 × 6 cm., occasionally bearing tufts of healthy hair within the areas. Crusts about 4-7 mm. thick in the center, thinner toward the edges, not very adherent. Hairs gray, covered by a spore sheath and broken only 2-3 mm. above the skin. Cells in sheath cylindric 5-6μ in diameter, thick-walled, united into dichotomous hyphae. Spores in chains, spherical or ellipsoid, 6-8μ in diameter, the chains soon disappearing. The crust results from an enormous hypertrophy of the horny layer, the epidermis is dissociated by the extravasation of serum in certain points and at other points invaded by polynuclears which sometimes form small abscesses, especially at the surface of the epidermis in contact with the horny layer. The dermis is infiltrated by mononuclears, especially in the vicinity of the follicles. Sometimes the follicles themselves are invaded by the polynuclears. Inoculable to guinea pig, producing a small evanescent lesion, with only a few hairs invaded and a few scales, healing spontaneously in a few days.

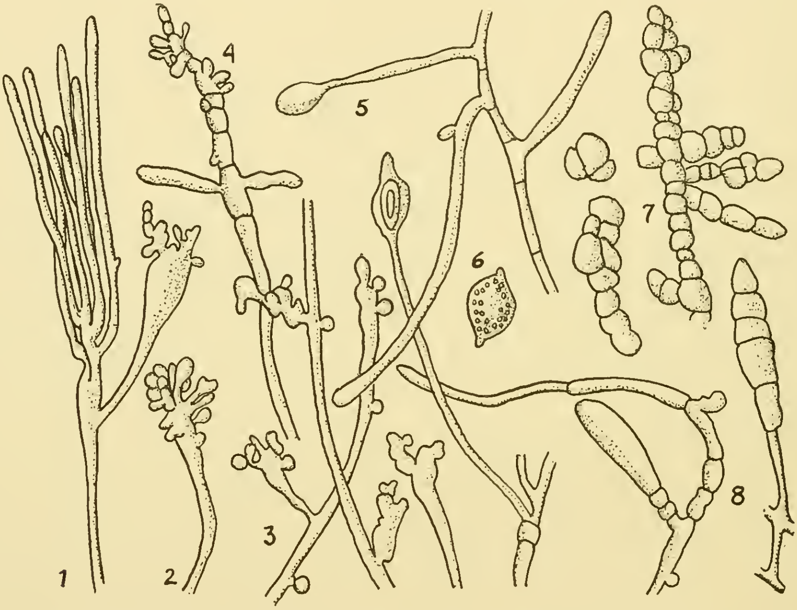

Fig. 86.—*Favotrichophyton camerounense.* *1,* hyphal tips showing branching suggesting favic candelabra; *2-4,* short lateral branches suggesting aleurospores; *5, 6,* pedicellate chlamydospores; *7,* arthrospores; *8,* chain of arthrospores suggesting a closterospore. (After Ota & Gaillard 1926.)

In cultures, arthrospores in chains, of variable size up to 12μ in diameter, sometimes chains resemble closterospores in general form, but nothing is known of their cytology (Fig. 86, *7,8*). The hyphae are about 4μ in diameter, septate, branched, not flexuous. Sometimes very short lateral branches are formed, which suggest young aleurospores, but these are not abjointed, and never mature to spores (Fig. 86, *2, 3*). Sometimes the terminal portion is branched, suggesting the favic candelabra of *Achorion* (Fig. 86, *1*). Pedicellate chlamydospores abundant, 10-15μ in diameter, occasionally up to 20μ, sometimes detached from the mycelium (Fig. 86, *5, 6*).

Colony at first whitish, elevated, hemispheric with a very thin velvet, growth very slow. On glucose agar reaching a diameter of 5 mm. in 40 days, acuminate, the central portion remaining hemispheric, the margin with radial folds. Colonies very hard and adherent. On conservation medium, growth more rapid, in general suggesting colonies of *Favotrichophyton album*.

Favotrichophyton Langeroni (Baudet) Dodge, n. comb.

Grubyella Langeroni Baudet, Ann. Parasitol. Hum. Comp. **8**: 411-418, 1930.

Producing crusts in circular lesions on dromedary. Inoculable in guinea pig, lesions giving fleeting resemblance to favus.

Mycelium 4-4.5μ in diameter; arthrospores abundant, 6-10μ, sometimes in chains terminated by mycelial branches; aleurospores budding from irregularly inflated cells; chlamydospores intercalary or terminal, not pedicellate; accessory organs various, sometimes suggesting favic candelabra or closterospores.

Colonies white, conic, sometimes furrowed as is a snail shell, with a short white velvet.

Favotrichophyton Urenae (Ochoterena) Dodge, n. comb.

Sabouraudites (*Aleurocloster*) *Urenae* Ochoterena, Revista Mex. Biol. **4**: 94-100, *7 figs.*, 1924.

Case history by Gonzales Urueña, Revista Mex. Biol. **4**: 90-93, 1924.

Very severe case of tinea tonsurans affecting a large portion of the hair, Mexico.

Arthrospores 5-8μ, in the hair, aleurospores lateral, chlamydospores present, closterospores pluriseptate, 2-7-celled.

Central portion of colony cerebriform or folded, dry, white, margin broad and flat, no radial furrows.

Favotrichophyton abissinicum (Agostini) Dodge, n. comb.

Bodinia abissinica Agostini, Atti Ist. Bot. R. Univ. Pavia. IV, **2**: 117-125, 1930 [1931].

Causing tinea capitis of native in Eritrea.

Colonies white, floccose, spreading. Hyphae emerging from substrate, then more or less adhering, branched, septate, 3-7μ in diameter. Arthrospores 4-9μ in diameter, rounded, oblong or irregular, solitary or in irregular chains, intercalary or acrogenous, suggesting conidia. Chlamydospores intercalary, irregular 14-20 × 40μ.

Differs from *F. violaceum* and *F. glabrum* by abundant and irregular formation of chlamydospores and from *F. balcanicum* by the branching of the mycelium.

Favotrichophyton floreale (Cazalbou) Dodge, n. comb.

Trichophyton floreale Cazalbou, Rev. Gén. Méd. Vét. **24**: 6, 7, 1914.

Isolated from lesions on bull, St. Brieuc, France, material sent by Sérisé, not reported since the original case.

In the lesions, arthrospores 5-6μ in diameter.

Colonies greenish yellow, citron color, flat, somewhat convoluted, but the convolutions sunk in agar, suggesting the petals of a flower, with a wide velvety margin.

Favotrichophyton floriforme (Beintema) Dodge, n. comb.

Trichophyton floriforme Beintema, Arch. Derm. Syphilis **169**: 577-581, *6 figs.*, 1934.

Isolated from tinea tonsurans, *Sabouraudia* type with pustules, in Groningen, Netherlands. Slight scaling on guinea pig after 10 days, but no invasion of the hair and spontaneous healing in 3 weeks.

Hyphae 3-5μ in diameter often ending in clavate swellings about 8μ in diameter. Aleurospores in clusters; chlamydospores terminal, lateral, or intercalary 12-18μ. Only chlamydospores in peptone solution.

Colonies with a broad zone below the surface of the medium, smooth with radial furrows, margin not especially radiate, cream color with a slight umbilicate center, and a finely crackled surface. On Grütz agar, growth more rapid, yellowish green with central umbilicate and folded area and a flatter margin, the center finally becoming cream color and the yellow green moving toward the margin. The radial furrows are very regular and suggest the petals of a flower, whence its name. Center finally crackled.

Except the host there seems little to differentiate this species from the preceding, but I have preferred not to reduce it to synonymy in the absence of a suggestion that it might have been contracted from a member of the Bovidae.

Favotrichophyton flavivirens (Americo da Veiga) Dodge, n. comb.

Trichophyton flavivirens Americo da Veiga, Brasil Med. **43**: 836, 837, 1929.

Producing alopecia and kerions on Portuguese in Brazil.

Arthrospores 4-6μ, in cuticle of hair and follicle.

Colonies humid, of two concentric discs, the higher and inner one yellow cream, the lower and outer white. Subcultures similar but central plateau green, outer yellow cream.

Favotrichophyton balcaneum (Castellani) Dodge, n. comb.

Trichophyton balcaneum Castellani, Jour. Trop. Med. Hyg. **22**: 173, 174, *2 figs.*, 1919.

Bodinia balcanea Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Producing pseudopityriasis capitis in Macedonia.

Mycelium hyaline, 3-4μ, intricately branched, with chlamydospores and nodular organs.

Colony yellowish white, glabrous, elevated above the substrate, a central boss with many short radial furrows. On glucose agar, growth very slow. On gelatin liquefaction rapid.

Favotrichophyton luxurians (Brault & Viguier) Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Trichophyton luxurians Brault & Viguier, C. R. Soc. Biol. **77**: 342, 343, 1914; Bull. Soc. Franç. Derm. Syphiligr. **25**: 401, 402, 1914; Brault, Ann. Derm. Syphiligr. V, **6**: 91-94, 1916.

Ectotrichophyton (Favotrichophyton) luxurians Castellani & Chalmers, Man. Trop. Med. ed. 3, 1004, 1919.

Grubyella luxurians Brumpt. Précis Parasitol. ed. 4, 1305, 1927.

Producing kerion on children in Algeria. Inoculable to guinea pig, producing scales surrounding the hair, erythematosquamose lesions with infiltration and bloody crusts. Probably the organism of Artom (1933) belongs here.

In hair, mycelium irregularly septate, either straight or flexuous; arthrospores abundant outside the hair, 5-7μ.

Only slightly moniliform mycelium formed in hanging drops. Artom (1933) reports chlamydospores but no closterospores or aleurospores.

Colony faviform, becoming waxy, slightly humid, more yellowish, vermiculate with little cupules, drying yellowish gray, surface slightly powdery; center verrucose, much elevated; margin with a short velvet.

Favotrichophyton ceroton (Cazalbou) Dodge, n. comb.

Trichophyton ceroton Cazalbou, Rev. Gén. Méd. Vét. **24**: 2, 3, 1914.

Trichophyton faviforme album Gregorio, Actas Dermo-Sifiliograf. [1-7] 1934.

Produces lesions with grayish crusts the size of a 2-franc piece on bulls, Côtes-du-Nord, France. Apparently the outbreak in Asturias reported by Gregorio (1934) should be referred here, or perhaps to *F. luxurians*.

Arthrospores about roots of hair, 5μ, spherical, hyphae 3μ, straight, dichotomous and usually numerous on and within the cuticle of the hair.

Colonies on maltose agar elevated, yellowish, folded and contorted, glabrous, color of virgin wax, whence its name.

Favotrichophyton cinereum (Cazalbou) Dodge, n. comb.

Trichophyton cinereum Cazalbou, Rev. Gén. Méd. Vét. **24**: 5, 6, 1914.

?Achorion sp. Truffi, Arch. de Parasitol. **11**: 419-424, 1907.

Isolated from Durham cow at Rennes, France, irregular lesion with slight confluent crusts of cacao color. Later found on 6 bulls, oxen, or calves coming from Mayenne and Loire-Inférieure, not reported since. Perhaps human lesions reported by Truffi (1911) were produced by this species. It is probable that the *Trichophyton faviforme du veau* described by Bodin, C. R. Soc. Biol. **48**: 711-713, 1896, and later named *T. verrucosum* var. *Vituli* Neveu-Lemaire, Précis Parasitol. Anim. Domest. 76, 1912, belongs here, although it has been too briefly described to be placed with certainty.

Hairs mildly parasitized with slightly sinuous mycelium and polyhedral spores, 4μ in diameter about the roots.

Colonies bright orange yellow, forming small tuberculiform masses, after 45 days becoming grayish blue, ashy, 12-15 mm. in diameter, cerebriform with a floccose white velvet about the margin.

Favotrichophyton expansum (Cazalbou) Dodge, n. comb.

? *Trichophyton planum fuscolargum* Rosenbach, Ueber die tiefen eiterenden Schimmelerkrankungen der Haut 34, 1894.

Trichophyton expansum Cazalbou, Rev. Gén. Méd. Vét. **24**: 7, 8, 1914.

Produced isolated lesions the size of a 5-franc piece, covered with a thick crust of gray scales on two Norman bulls from Mayenne, France. Not reported since original case.

Arthrospores about the roots of the hairs, 4-6μ and large, slightly sinuous hyphae invading the hair.

Primary cultures produce small rounded yellowish masses. In older cultures and in subcultures a large cerebriform much folded central mass with a yellowish gray smooth border under the surface of the medium. On Sabouraud maltose the folds are thicker, less numerous and covered with a fine white velvet. On Sabouraud glucose, colonies still glabrous and yellow at the center. After pleomorphism has set in, colony has a small wrinkled center with somewhat irregular radial folds and furrows, about 5 of the former and 12 of the latter.

Favotrichophyton coronatum (Cazalbou) Dodge, n. comb.

Trichophyton coronatum Cazalbou, Rev. Gén. Méd. Vét. **24**: 3, 4, 1914.

Produced lesions on backs of 2 bulls and an ox, with crusts of cacao color. France. Not reported since original case.

Fungus ectothrix, arthrospores 6μ.

Cultures small grayish or yellowish buttons, central area 8-10 mm., crater with folded edges, slightly eccentric, festooned around the base, a crown of fine silver white velvet 2-3 mm. broad. Somewhat resembles *T. ochraceum* Sabouraud, but differs in the marginal crown and is not inoculable into the guinea pig.

Favotrichophyton pruinosum (Catanei) Dodge, n. comb.

Trichophyton pruinosum Catanei, Bull. Soc. Path. Exot. **24**: 296-301, *1 pl.*, 1931; Arch. Inst. Pasteur Algérie **11**: 347-349, *Pl. 42, Figs. 9-15,* 1933.

Isolated from a sheep, lesion of ectothrix megaspore type. Inoculation into sheep gave crusts which lasted 2 months but lesion finally disappeared. Inoculable to guinea pig, crust showing the tenth day, healing spontaneously within 3 weeks. Inoculable to calf, thick scales in 12 days, spontaneous healing in 6 weeks.

Spores in sheath and in hair 3.5-4μ in diameter. In culture, hyphae 4-4.5μ, septate, branched; arthrospores in simple or branched chains, 4-10μ long, averaging 6-7μ; terminal and intercalary chlamydospores present. The mycelium sometimes shows abortive beginnings of branches but no true aleurospores.

No isolation at 22° although transplants grew at this temperature. On Sabouraud agar, primary colonies slightly elevated, glabrous and irregular 3-12 mm., margins with short rays, color varying from that of *F. violaceum* to a grayish yellow. Secondary colonies glabrous, slightly elevated, irregular, violet brown or brownish yellow, with small central dome 1.5-2 mm. high and

2 mm. in diameter often covered with hyphae or even tiny coremia, marginal rays sunk in the substrate, short. Some colonies are almost reduced to this central dome. Surface moist and shining at first, finally becoming velvety sometimes with slight irregular furrows. On Sabouraud conservation agar, colonies smaller, brownish yellow or violet, glabrous, irregular. On potato or carrot, small irregular masses, glabrous, grayish white, sometimes with tiny coremia. On wheat, colonies moist and shining at first, becoming dull. On barley, growth better and grayish white, becoming velvety. Pleomorphism in cultures incubated at 28° C.

Favotrichophyton conicum (Cazalbou) Dodge, n. comb.

Trichophyton conicum Cazalbou, Rev. Gén. Méd. Vét. **24**: 4, 5, 1914.

Isolated from a horse during an epizoötic of *Trichophyton equinum,* France. Not reported since original case.

Spores in lesions 2.5-4μ, less ectothrix than *T. equinum,* same size on guinea pig as on horse.

Culture tubercular, yellow or orange, conic, base 1-2 cm., tip irregular and obtuse, 5-8 mm. above the medium. Ochraceous on maltose, bright yellow on glucose, variously channeled, margin velvety.

Favotrichophyton ochraceum (Sabouraud) Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

? Trichophyton fuscum tardum Rosenbach, Über die tiefen eiternden Schimmelerkrankungen 30, 1894.

Trichophyton ochraceum Sabouraud, Ann. Derm. Syphiligr. IV, **9**: 628-834, *1 pl.,* 1908.

Ectotrichophyton ochraceum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1004, 1919.

Grubyella ochracea Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Arthrosporia ochracea Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 414, 1925.

Achorion (Bodinia) ochraceum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing kerions and large circinate lesions on man, inoculable into guinea pig; probably also on domestic animals, but cases not proved.

This species is usually combined with *F. album* and *F. discoides* in statistics. The group is reported as common in China, Algeria, and France; occasional in Holland, Holstein, Denmark, Süd-Bayern, Poland, and Uruguay.

Only mycelium and chlamydospores present in cultures.

Colony a small, yellow ochre tubercle, with a border of sulphur yellow. On aging, covered with a very short velvet, scarcely visible except on central portion which may be 1 cm. long, acuminate, and retains its yellow ochre color. On glucose agar, margin with a short fringe of arborescent rays, white. On peptone agar, colony more like *Achorion,* a rounded mass, somewhat cerebriform, gray, a little yellowish.

Favotrichophyton caballinum Neveu-Lemaire, Précis. Parasitol. Hum. 55, 1921.

Trichophyton faviforme à culture brune du cheval Bodin, Les teignes tondantes du cheval. 90-100, Thèse Paris, 1896; C. R. Soc. Biol. **48**: 711-713, 1896.

Trichophyton verrucosum Bodin (pro parte), Champ. Paras. Homme 121-124, 1902.

Grubyella caballina Brumpt. Précis Parasitol. ed. 4, 1304, 1927.

Epizoötic following introduction of a horse from Denmark into a stable in France. On horse, lesions 5-6 cm. in diameter, soon confluent, covered with dry crusts, with vesicopustules under the scales, only one hair in 10-15 infected, pure ectothrix type. Nine men infected during the epizoötic. On man, the parasite was endoectothrix, producing a thick kerion.

Growth slow and poor in cultures. On Sabouraud agar, small brown cerebriform mass after 4-5 weeks. Still slower growth on malt agar. On potato, small, grayish, isolated, little elevated colonies after 3 weeks.

Favotrichophyton Gourvili (Catanei) Dodge, n. comb.

Trichophyton germen II Gregorio, Actas Dermo-Sifiliograf. **23**: 714-718, 1931.

Trichophyton Gourvili Catanei, Bull. Soc. Path. Exot. **26**: 377-381, *Pl. 1,* 1933; Arch. Inst. Pasteur Algérie **11**: 341-346, *Pl. 42, Figs. 1-8,* 1933; Rusin, Thèse Univ. Paris **497**: 39, 40, 1933.

Isolated from tinea capitis of the endothrix type in Algeria. Inoculable to guinea pigs, producing lesions of the endothrix type, which healed spontaneously in 50 days.

Hyphae irregular, producing arthrospores and rather large chlamydospores. Aleurospores pyriform, 5 × 3μ, occasionally up to 6.5 × 4μ, not very common on Sabouraud media, but abundant on grains of barley, sometimes in compound groups. Transitional forms between closterospores and arthrospores seen on barley.

On Sabouraud agar, colonies glabrous, waxy at first, forming a small, prominent central mass with a festooned margin, becoming cerebriform with many short radial furrows of unequal depth. Color varying from pale mauve to violet, as in *F. violaceum.* Pigment less developed at lower temperatures. After 5-6 weeks, more velvety and powdery. On Sabouraud maltose, center sharper with fewer convolutions and furrows, waxy yellowish, dirty gray, or slightly bister, growth poorer. On Sabouraud conservation agar, colony cerebriform, slightly elevated with irregular periphery, waxy, with slightly dull surface, grayish yellow. On barley, whitish, powdery or slightly velvety, very pale grayish violet. On corn (maize), similar to those on barley but with deeper violet color. Pleomorphic mycelium white, velvety.

Favotrichophyton glabrum (Sabouraud) Dodge, n. comb.

Trichophyton glabrum Sabouraud, Maladies du cuir chevelu **3**: 312, 1910.

Bodinia glabra Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Found once on a Jewish child from Russia; producing tinea tonsurans, common in Algeria, clinically similar to *F. violaceum;* inoculable to guinea pig (Catanei 1929, 1933).

Primary colonies variable in size, center with irregular folds or a central knob with few radial furrows. Growth more rapid than *F. violaceum*, 4 cm. in 6 weeks, never violet, pale brown, surface moist and shining on maltose, colonies flat with large thick papillae in the center, also moist and of the same color. In flask cultures, the center may remain glabrous, but be surrounded by a ring of papillae. On dextrin agar colonies similar with a brownish aureole several millimeters in diameter. No trace of pleomorphism.

Favotrichophyton violaceum (Sabouraud ap. Bodin) Dodge, n. comb.

Trichophyton à culture violet foncé Sabouraud, Ann. Derm. Syphiligr. III, **3**: 1061-1087, *2 pls.*, 1892; Trichophyties humaines 128, 129, 1894.

Trichophyton violaceum Sabouraud apud Bodin, Champ. Paras. Homme 113, 1902.

Bodinia violacea Ota & Langeron, Ann. Parasitol Hum. Comp. **1**: 329, 1923.

Arthrosporia violacea Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 414, 1925.

Producing tinea tonsurans, herpes circinata, onychomycosis and sycosis, in man, apparently largely, if not wholly, confined to the Semitic group, from Russia and Poland to France and from Palestine to Algeria and portions of the Sudan whence it was originally described. In America, largely confined to immigrants from these regions or their children. Inoculable on *Macacus inuus* (Catanei 1928) guinea pig, dog, and cat by Catanei (1929). Prochaska (1926) reports an outbreak among Kalmuk immigrants from the Don region attending a gymnasium in Praha. It did not spread to other students.

Colony violet (rarely bister at first), rounded, often with a little button at the center. Surface shining, with five or six regular radial folds. No pigment at 37° C. (Weiss 1930). After a few subcultures or at lower temperatures the violet color begins to be lighter, the colony grows faster, becomes yellowish gray with a tendency for the folds to become contorted, sometimes pigment limited to one segment. On old cultures the velvet is short, white, covering from a third to a half of the colony leaving free the violet center. Growth about half as fast as in *Trichophyton tonsurans,* rarely more than 3 cm. in diameter. On Pollacci agar, dark brownish red (Fujii 1931). No pleomorphism but old cultures may become powdery, velvety, or chalky and grayish white. On transplants the normal colony reappears. On potato and carrot, colonies similar to those on Sabouraud media. On coagulated serum, colonies small, whitish and glabrous. No growth on wheat.

The moistness of the colony suggests the faviform group. Pleomorphism present. If this organism is of animal origin, such a source has not been proved, although Sabouraud suspects the dog; Mibelli, the horse; and Minne, domestic fowls or pigeons.

Var. **khartoumense** (Chalmers & Macdonald) Dodge, n. comb.

Trichophyton violaceum var. *khartoumense* Chalmers & Macdonald, Jour. Trop. Med. Hyg. **18**: 145-147, *1 pl.*, 1915.

Producing tinea capitis in Sudanese schoolgirl with no traces of the ectothrix stage or inflammation in old patches.

The central knob is pomegranate purple (Ridgway), the plateau is blackish red purple, the medium becomes scarlet red (Ridgway). Gelatin promptly liquefied.

Var. **marginatum** (Muijs) Dodge, n. comb.

Trichophyton marginatum Muijs, Nederl. Tijdschr. Geneesk. **65**: 2:2205-2207, 1921.

Isolated from cases of tinea capitis endothrix in Holland, not inoculable to guinea pigs.

Only chlamydospores and aleurospores present, no closterospores.

Moist, shining, light brown surface, center with fine spines. After a few weeks, a narrow violet border on Sabouraud agar, lacking on media without sugar. On milk, pale violet. No pleomorphism.

Var. **coccinatum** Dodge, n. var.

Trichophyton violaceum var., Ballagi, Derm. Woch. **83**: 1155-1169, 1926.

Differs from *T. violaceum* by its scarlet red colony with blood red submersed marginal strands; not inoculable into experimental animals.

Favotrichophyton coccineum (Katoh) Dodge, n. comb.

Trichophyton coccineum Katoh, Trans. 6th Congr. Far Eastern Ass. Trop. Med. Tokyo, 861-865, 1925.

Producing tinea tonsurans, *Sabouraudia* type with occasional hair silvery gray, 1-2 mm. long; also from herpes circinatus and onychomycosis common in Kyushu, not yet found in Japan. On glabrous skin, dark reddish seropapules, covered with pityriasiform scales, slight pruritus. Inoculation of child showed endothrix lesion; in guinea pigs, rabbits and dogs, positive ectothrix.

Spores in hair 7μ, in scales mycelium 3-4μ, arthrospores 5-6μ. In culture, mycelium 3μ, septate with racquet mycelium; aleurospores on compound thyrses. Chlamydospores pedicellate or intercalary, large, often irregular.

Colony on Sabouraud glucose, at first moist cream color, growth rapid, center dark, brownish purple with cream color border, 8 mm. on fourth day, powdery velvet in center on eighth day. In fourth week, colony 5-6 cm. Pleomorphism beginning in central disc as small protuberance with pink velvet, surrounded with dark brownish purple, with powdery disseminated velvet and 4-8 radial folds; margin cream color. On Pollacci agar, dark gray and shining.

Favotrichophyton spadix (Katoh) Dodge, n. comb.

Bodinia spadix Katoh, Trans. 6th Cong. Far Eastern Ass. Trop. Med. Tokyo 865, 866, 1925.

Bodinia spadicea Pollacci & Nannizzi, *I* Miceti Pat. dell 'Uomo e degli Anim. **10**: No. 91, 1930.

Isolated from tinea tonsurans, *Sabouraudia* type, on child, Loochoo Islands. Inoculable into guinea pig, rabbit, dog, and cat, found only in hair of guinea pig, in scales of other experimental animals.

Hyphae 3μ in diameter, branching scarce; racquet mycelium present. Intercalary and terminal chlamydospores abundant. Arthrospores abundant in old cultures. Katoh reports rudimentary sporiferous thyrses in pleomorphic colonies.

Colony grayish white becoming chestnut or dark brown, surface of small glabrous nodules, humid. In 3 weeks, the colony is surrounded by a broad crown of rays, forming a disc 4-5 cm. in diameter. The mass of central nodules is still evident, the surface either still smooth or covered by a short, whitish powdery lanugo. On Sabouraud maltose and on peptone agar, colonies similar but pleomorphism develops with long white hyphae. On Pollacci agar, it forms a rounded colony, mammillate, glabrous, humid. Surface chestnut with a whitish bloom, but reverse wine red color diffusing into substrate.

Close to *F. violaceum,* differing principally in color.

Favotrichophyton avellaneum Dodge, n. nom.

Trichophyton Langeroni Milochevitch, Ann. Parasitol. Hum. Comp. **9**: 456-461, *1 pl.,* 1931, not *Grubyella Langeroni* Baudet, *Favotrichophyton Langeroni* (Baudet) Dodge.

Dry lesions with scales and broken hairs, on Jewish boy in Belgrade. Inoculable into guinea pig, monkey, and calf (Catanei 1932).

In hair, arthrospores very small (endothrix microïde of Ota & Kawatsuré, 1931, resembling tropical *Endodermophyton concentricum*).

In faviform colonies, hyphae 2.5-5μ, tortuous at the extremity, septate, branched, tips clavate, arthrospores and intercalary or terminal chlamydospores present, favic candelabra, and lateral buds suggesting aleurospores (?) of *Trichophyton;* (?functional) chlamydospores (more normal in appearance), filled with sudanophile granules. Probably none of the media tried were really favorable to best growth.

Colonies irregular, not elevated, slight avellaneous boss, margin of thick irregular, branched rays, surface smooth, dry, with marginal rays reaching surface in places and suggesting islands of an archipelago around the central mass very different from the delicate transparent rays forming a halo around the usual dermatophyte. Initial cultures developing very slowly, subcultures more rapidly. On horse dung, only slight development, none on barley, slight flakes on wheat water, very slight on soluble starch and dextrin. No trace of pleomorphism.

Favotrichophyton verrucosum (Bodin) Neveu-Lemaire, Précis Parasitol. Hum. 55, 1921.

Trichophyton faviforme à culture grise [*de l'âne*] Bodin, Les teignes tondantes du cheval, 101-110, Thèse Paris, 1896; C. R. Soc. Biol. **48**: 711-713, 1896.

Trichophyton verrucosum Bodin, Champ. Paras. Homme 121-124, 1902.

Trichophyton verrucosum var. *asini* Neveu-Lemaire, Précis Paras. Anim. Domest. 75, 1912.

Ectotrichophyton (Favotrichophyton) verrucosum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1003, 1004, 1919.

Isolated from glabrous, irregular, dry areas covered with a thick layer of grayish scales without underlying suppuration, folliculitis or broken hairs, on neck and ears of donkey. Transmitted to three out of four persons who cared for the animal. Human lesions red, scarcely scaly circles with small vesicopustules filled with a creamy white pus. Produced an ectothrix lesion on guinea pig.

Colony round, immersed disc 2 cm. in diameter, central elevated knob gray with a grayish white margin, humid with radial furrows. On malt agar, colony acuminate, gray, size of a pea surrounded by immersed rays, branched as a fern leaf, surface rough, growth slow. On potato, growth slow, gray, humid, little elevated, verrucose, finely tomentose in places.

Favotrichophyton fuligineum (Ogata) Dodge, n. comb.

Trichophyton fuligineum Ogata, Jap. Jour. Derm. Urol. **29**: 1183-1232, *Pl. 41, 25 figs.*, 1929.

Bodinia fuliginea Ogata, Jap. Jour. Derm. Urol. **29**: 1183-1232, *Pl. 41, 25 figs.*, 1929.

Isolated from tinea tonsurans, *Sabouraudia* type at center of lesion, no hair at margins, hair silver white, breaking 2-3 cm. from scalp. Spores in hair 4-5μ. Inoculable into guinea pig, rabbit, cat, and dog. Inoculation in man produced 1 kerion, 2 maculovesiculose lesions and 1 superficial lesion. Organism reisolated from all cases.

Hyphae 3-4μ. Chlamydospores intercalary and terminal as in *F. violaceum*, colored grayish yellow. Few aleurospores noted.

Growth slow, 1 cm. in 3 weeks, surface shining and smooth, center folded and knotted, greenish black, margin grayish white. Medium colored blackish green. Similar on 4% honey agar and on 40% koji agar. On glucose agar, colors brighter, suggesting a film of petroleum on water. On Pollacci agar, colony greener.

Favotrichophyton epilans (Mégnin) Dodge, n. comb.

Trichophyton depilans Mégnin, Arch. Gén. Méd. **141**: 294-304, 1878 [nom. nud.].

Trichophyton epilans Mégnin, Bull. Soc. Centr. Méd. Vét. **44**: 183-186, 1890.

Lesions on calves in Normandy, very contagious to man, producing sycois, and to horse. Crusts yellowish, not clay color. Hairs not breaking above the skin but falling completely, with pus [?] formation in the follicle. Spores in lesions 5-6μ in diameter, yellowish. Lesions on horse similar, but smaller.

Colonies slightly yellowish on gelatin, rapidly liquefying the substrate.

This species has been too briefly described for certain identification, but the formation of yellow crusts seems distinctive.

TRICHOPHYTON

Trichophyton Malmsten, Trichophyton tonsurans hårskärande Mögel, 1845; (tr. Arch. Anat. Physiol. Wiss. Med. [Müller] **1848**: 1-19, 1848).

Type Species: *Trichophyton tonsurans* Malmsten. Since Malmsten did not cultivate his organism, botanists have been agreed to refer the very common species of tinea tonsurans with a crateriform colony, which Bodin discusses under the name *Trichophyton crateriforme* Sabouraud, to *Trichophyton tonsurans* Malmsten.

Only chlamydospores, arthrospores, and aleurospores present, the latter usually on simple thyrses; lesions of the tinea tonsurans type with the relatively large arthrospores wholly in the hair. In a few species (in the early stages of infection, the arthrospores may be found both without and within), the giant colony velvety, neither moist and glabrous nor very powdery; if infection is transferred to the glabrous areas, usually there are produced dry scaling areas with very little or no inflammation.

This genus, comprising the sections *Neoendothrix* and *Endothrix* of Sabouraud, is a natural group of closely related species. In the *Neoendothrix* section, usually producing sycosis, rarely tinea capitis, the early stage of infection, during which arthrospores are produced both outside and inside the hair, persists for a longer time than in the other groups hence, in examining a large number of hairs of a given area, about one-fifth will ordinarily show this early stage. The section *Endothrix* of Sabouraud usually producing prepubertal tinea capitis might well be divided into two subsections: *Malmstenia,* the more primitive with its crateriform colony in which the hair or a considerable portion thereof is bent and folded and embedded in the scale (*Trichophyton tonsurans* type) and *Sabouraudia,* the more advanced type with an elevated or acuminate type of colony and with the hair breaking off sharply at the mouth of the follicle (*Trichophyton Sabouraudi* type).

Key to Trichophyton

Colonies crateriform at first, becoming cerebriform, lesions of the Neoendothrix type, usually sycosis, rarely tinea capitis.
  Colony white, becoming cream color and yellowish in the center, crackled, marginal rays distinct and unequal. *T. flavum.*
  Colony soon sulphur yellow, then light brown, becoming red brown. *T. ochropyrraceum.*
  Colony remaining white, outer folds radiating, inner less contorted than in *T. flavum,* margin powdery, rays less visible, folds cracking in old colonies. *T. plicatile.*
Colonies remaining crateriform, lesions of the *Malmstenia* type, usually tinea capitis, predominantly prepubertal.
  Colony zonate, center dark cinereous, then lanuginous, clear green, a narrow darker ashy zone, a green zone and a white margin; subcultures with black center and zones of dark brown (Havana cigar color). *T. bicolor.*
    Colony not zonate, brown.
      Colony smoke brown (color of dead leaves), umbo in center of crater soon disappearing, periphery with periclinal furrows about 1 mm. apart. ***T. fumatum.***

Colony coffee brown or roebuck brown, central crater disappearing in a month, leaving a deeply reticulate wrinkled colony. *T. fuscum.*

Colony yellow or cream color, rarely pure white.

Colony sulphur yellow, base of crater irregular, interior somewhat folded, red orange. *T. sulphureum.*

Colony white velvety, central portion becoming yellowish, small button in the middle of the crater; on Sabouraud conservation agar, colony contorted, less crateriform, wholly white, sometimes cracking about the edge of the crater, surrounded by immersed rays. *T. tonsurans.*

Colony smaller, soon cracking deeply on the edge of the crater, marginal zone folded deeply with immersed fringe. var. *effractum.*

Colony white, crater irregular, crackled, many radial furrows, growth slow. var. *exsiccatum.*

Colony white, velvety at first becoming powdery, margin polygonal, often quadrilateral, surface of thick round folds. *T. polygonum.*

Colony cream white, walls of crater bending inward, folded, suggesting the mouth of a pouch closed by a draw string. *T. regulare.*

Colony resembling a conventionalized flower when young, deeply umbilicate in age (suggesting the blow end of an apple). *T. umbilicatum.*

Colony powdery, white, central button raised 1.5 cm. above rest of colony, finally crateriform, margin cream color; reverse wine red under crater, rest mahogany brown. *T. rotundum.*

Colonies heaped up, not depressed or crateriform, lesions of the endothrix type (*Sabouraudia* subtype), usually tinea capitis and prepubertal.

Colony cerebriform, usually more elevated and contorted than in the *T. flavum* group (perhaps this whole group belongs in *Favotrichophyton* sect. *Bodinia*).

Colony suggesting *Achorion* when young.

Cerebriform and crackled in age, color unknown; lesions on buttocks, and tinea tonsurans (*Malmstenia* type). *T. circumvolutum.*

Cerebriform to vermiculate, less elevated and more spreading, violet in primary cultures, color fading in subcultures. *Favotrichophyton violaceum.*

Colony cerebriform in center, margin broad, flat, dry, white, no furrows. *Favotrichophyton Urenae.*

Colony acuminate, sometimes umbonate.

Colony zonate.

Inner zone dirty purplish red, then a deep periclinal furrow, then an elevated red fold, moist dirty white with outer fringe of radial hyphae; radial furrows, crackled in the center. *T. areolatum.*

Umbonate, dark ashy, surrounded by a darker furrow, then a zone of dull ashy and a white margin; reverse black. *T. cineraceum.*

Colony not zonate.

Colony white, circular; subcultures yellower and more filamentous. *T. acutulum.*

Colony with long coremia at the center, powdery, cream color becoming brownish, sometimes with a violet tint, becoming a flattened cone with radial furrows and a thin flat margin.

Colony powdery. *T. Sabouraudi.*

Colony pilose. var. *pilosum.*

Colony irregular, not elevated, but with a slight boss, avellaneous, margin of thick irregular branched rays which become powdery where they reach the surface, suggesting islands of an archipelago.
Favotrichophyton avellaneum (p. 525).

Colony white with yellow peak in center which becomes folded in age.
T. soudanense.

Colony (at 37° C.) white central peak surrounded by a periclinal furrow, two concentric zones and marginal fringe usually with four slight radial folds; closterospores very rare, chlamydospores abundant.
Ateleothylax Currii (p. 431).

Trichophyton flavum Bodin, Champ. Paras. Homme 119, 120, 1902.

Trichophyton à culture jaune, craquelée, vermiculaire, Sabouraud, Ann. Derm. Syphiligr. III, **4**: 815, 1893.

Trichophyton cerebriforme Sabouraud, Maladies du cuir chevelu **3**: 321-330, 1910.

Neotrichophyton flavum Castellani & Chalmers, Man. Trop. Med. ed. 3, 1002, 1919.

Causes tinea barbae and rarely prepubertal tinea capitis or herpes of glabrous skin; seven cases on conjunctiva (Deuchler 1930) in man, not yet found spontaneously in animals, but inoculable into guinea pig. The early report by Sabouraud of finding it on horse, was probably incorrect, being furnished by a series of misunderstandings, the cultural characters sometimes quoted by later authors for *T. depilans* Mégnin. Common in England, France, Italy, Germany, rare in São Paulo in Brazil and in Uruguay.

Terminal and intercalary chlamydospores and lateral aleurospores present; arthrospores abundant.

Colonies folded, cerebriform with a crater when young which disappears as the folds become prominent, white at first then cream color, finally yellowish in the center, crackled, marginal rays distinct and unequal, suggesting moss shoots when seen by transmitted light, powdery only where they reach the surface.

Trichophyton ochropyrraceum Muijs apud Papegaaij, Pathogene Huidschimmels 50-56, 1924; Papegaaij, Nederl. Tijdschr. Geneesk. **69**: 885, 1925.

Trichophyton crateriforme var. *ochropyrraceum* Keller, Derm. Zeitschr. **49**: 49, 1927.

Producing tinea capitis of the *Malmstenia* type, changing color of hair. Holland and Germany.

In hair, arthrospores 4.5-5μ.

Colony a small white hemisphere with long velvet, divided by a broad deep furrow, becoming light yellow, then deep sulphur yellow. In third week, cerebriform, light brown, becoming red brown, 6-7 cm. in diameter in 6 weeks, never pleomorphic.

Differs from *T. sulfureum* in being cerebriform and red brown, never with a red nodule in the center.

Trichophyton plicatile Sabouraud, Maladies du cuir chevelu **3**: 330-333, 1910.

?Trichophyton plicans fusisporum Rosenbach Über die tiefen eiternden Schimmelpilzerkrankungen der Haut 35, 1894.

Neotrichophyton plicatile Castellani & Chalmers, Man. Trop. Med. ed. 3, 1002, 1919.

Aleurosporia plicatilis Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Trichophyton (*Aleurosporia*) *plicatile* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing lesions in the beard (Sabouraud); also tinea capitis (Pini & Martinotti 1910). Inoculable into guinea pig. Common in Northern Italy, occasional in Germany and Poland, rare in Denmark, France, Montreal in Canada, and New York.

Lateral aleurospores and chlamydospores present.

Cultures of *Malmstenia* type, white, surface powdery, as if a piece of silk had been held by its middle and dropped, allowing it to fall into natural wrinkles, the outer wrinkles radiating, the inner ones, less contorted than in *T. cerebriforme*, margin powdery, less visibly radiating than *T. flavum*, occasionally in old colonies the folds crack, but less completely and constantly than in *T. effractum*.

Trichophyton bicolor Americo da Veiga, Brasil Med. **43**: 830-838, *4 figs.*, 1929.

In hair the usual characters of *T. endothrix* group, Brazil. Reported as quite contagious.

Arthrospores 3 × 5μ, chlamydospores 6μ.

Primary culture with center depressed, surrounded by broad zones; center dark cinereous, inner zone slightly lanuginous, clear green, then narrow ashy, darker zone, then green zone and white margin. First subculture in 50 days, central area black with zones dark tobacco color (Havana) and depression darker. Quite contagious.

Trichophyton fumatum Sabouraud apud Dalla Favera, Ann. Derm. Syphiligr. IV, **10**: 442, 1909; Sabouraud, Maladies du cuir chevelu **3**: 314, 315, 1910.

Trichophyton (*Chlamydoaleurosporia*) *fumatum* Guiart & Grigorakis, Lyon, Méd. **141**: 377, 1928.

Producing tinea tonsurans, common in Parma, and other cities of Northern Italy, very rare in Paris, Kiel in Germany, and Hungary.

Aleurospores lateral. Atypical closterospores reported by Catanei (1933).

Colonies type of *Trichophyton tonsurans*, on maltose a button with the center depressed with an elevated umbo, gradually disappearing as the colony becomes folded and furrowed, suggesting *T. effractum* without the fractures, color smoked brown of dead leaves, periphery often with concentric furrows about 1 mm. apart, but this feature not constant. On Pollacci agar, surface of irregular splintery elevations yellowish brown without a definite crater or umbo. A central yellow border with radial furrows. Pollacci and Nannizzi report appearance similar to that on Sabouraud agar. On Sabouraud peptone, similar to Sabouraud maltose, but flatter, color gray. On barley, colonies white powdery velvet.

Trichophyton fuscum Dodge, n. nom.

Trichophyton fuscum sulcatum Neuber, Derm. Woch. **80**: 861-872, 1925.

Producing sycosis, with broken hairs twisted spirally in the scales, in young men whose beard is just beginning to grow. Germany.

Aleurospores lateral or terminal; chlamydospores only in old cultures; arthrospores present. Microscopically close to *T. tonsurans*.

Colony coffee brown or roebuck brown, central crater disappearing in about a month, leaving a deeply reticulate, wrinkled colony.

It is interesting to note that this organism attacks the beard in the male before the gonads have reached their full activity; whether the lesions disappear spontaneously with the completion of puberty is unknown. In other respects the organism agrees closely with the other species producing prepubertal tinea capitis, *Malmstenia* type.

Trichophyton sulfureum Sabouraud, Maladies du cuir chevelu **3**: 317, 318, 1910.

Trichophyton with primrose colored crater T. C. Fox, Proc. R. Soc. Med. **2**: Derm.: 49-68, 1908.

Trichophyton sulfuratum Bessunger [nom. nud.], Unters. ü. Dermatomykosen Diss. Bonn 17, 18, 1915.

Trichophyton germen I. Gregorio, Actas Dermosifiliogr. **23**: 710-714, 1931.

Producing typical endothrix lesions, common in England, Australia, rare in Bonn, Germany, in Milan, Italy, and in Algeria.

Culture at first velvety, then a red nodule appears and the rest of the colony takes on a delicate yellow (primrose) color which persists as the colony grows and becomes powdery, its sulphur yellow color persists, center often speckled, and the base of the crater often irregular, interior often folded. The red orange of the center is paler in successive subcultures, but the yellow color is permanent. At 37° C., the colony is crateriform and red (Weiss, 1930).

Trichophyton tonsurans Malmsten, Trichophyton hårskärande Mögel 1845 [tr. Arch. Anat. Physiol. Wiss. Med. **1848**: 1-19, 1848].

Trichomyces tonsurans Malmsten, Trichophyton hårskärande Mögel 1845 [tr. Arch. Anat. Physiol. Wiss. Med. **1848**: 1-19, 1848].

Oidium tonsurans Zopf, Die Pilze, 482, 1890.

Trichophyton megalosporum endothrix Sabouraud, Trichophyties Hum. 17, 1894.

Trichophyton crateriforme Sabouraud in Bodin, Champ. Paras. Homme 108-110, 1902.

Chlamydoaleurosporia crateriformis Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 412, 1925.

Trichophyton (Chlamydoaleurosporia) crateriforme Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Produces tinea tonsurans of *Malmstenia* type (see pp. 445, 446), the commonest species of *Trichophyton* in Paris, apparently widespread in Western Europe. Inoculable to guinea pig, but lesion soon heals spontaneously.

Aleurospores both lateral and in thyrses. Hyphal tips often clavate. Aleurospores often sessile and showing transitional forms to small chlamydospores (cytology not reported in these cases).

White, velvety crateriform colony, becoming powdery with a small round button in the middle, central portion becoming yellowish (wholly yellow at 37° C.). On Sabouraud conservation agar, colony becomes contorted, less crateriform, wholly white, sometimes cracking about the edge of the crater. In age it is surrounded by immersed rays, although aerial growth is largely confined to the crater. Pleomorphic form rare, but occurs occasionally, pure white, somewhat crateriform, but edges less steep, with deep narrow radial furrows. On coagulated serum, colonies slightly umbilicate, moist, glabrous.

Var. **effractum** (Sabouraud) Dodge, n. comb.

Trichophyton effractum Sabouraud, Maladies du cuir chevelu **3**: 314, 1910.

Aleurosporia effracta Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Trichophyton (*Aleurosporia*) *effractum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Trichophyton sp. Sabouraud, Trichophyties Hum. Atlas 91, *Fig. 51*, 1893.

Lesions similar to those caused by *T. tonsurans*. Rare.

General form of culture close to *T. tonsurans* but smaller, some cracking deeply on the edge of the crater, marginal zone folded deeply with immersed fringe. These characters have remained constant for many years in culture.

Var. **exsiccatum** (Uriburu) Dodge, n. comb.

Trichophyton exsiccatum Uriburu apud Sabouraud, Maladies du cuir chevelu **3**: 318-320, 1910.

Producing tinea capitis infantum, endothrix type, clinical history unknown. From Buenos Aires, Argentina, from Milan, Italy, and from Hungary. Inoculation of guinea pig is positive and gives results similar to those of *T. tonsurans.*

Growth slow and difficult on test media, type of *T. tonsurans.* Crater irregular, crackled, on aging, surrounded by a broad white border with many radial furrows.

Trichophyton polygonum Uriburu apud Sabouraud, Maladies du cuir chevelu **3**: 318-320, 1910.

Clinical details lacking, cultures sent by Uriburu in 1909 from Argentina.

Colony crateriform at first, soon becoming polygonal and finally quadrilateral. Surface of thick round folds, white, velvety at first becoming powdery.

Trichophyton regulare Sabouraud apud Dalla Favera, Ann. Derm. Syphiligr. IV, **10**: 438, 439, 1909; Sabouraud, Maladies du cuir chevelu **3**: 316, 317, 1910.

Twice it produced tinea tonsurans, once involving beard; inoculable into guinea pig, common in Holland, Austria, Tomsk in Siberia; rare in Parma from which it was first described.

Microscopically similar to *T. acuminatum* (fide Bruhns & Alexander 1928).

Colonies of *T. tonsurans* type, the walls of the crater bend inward, radial folds very regular, the whole suggesting a pouch closed by a draw string, color cream white, less yellow than the other members of the group. Pleomorphism not observed.

Trichophyton umbilicatum Sabouraud, Maladies du cuir chevelu **3**: 315, 1910.

Trichophyton (*Chlamydoaleurosporia*) *umbilicatum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Produces tinea tonsurans, *Malmstenia* type. Rare in Cagliari, Venice, Bessarabia, and Boston, Mass.

Aleurospores lateral only, chlamydospores both intercalary and terminal, the wall ruptures allowing the contents to escape at the beginning of germination. Cytology of germination wholly unknown.

Young colony looks like a conventionalized flower. When older, deeply umbilicate in center like a maturing fruit, in old age, folded and contorted recalling the other species of this group. Velvet similar to that of pleomorphic colonies appears in old colonies but, when transferred, it gives rise to colonies similar to the original colony so that no true pleomorphism is known.

Trichophyton rotundum MacCarthy, Ann. Derm. Syphiligr. VI, **6**: 44-49, *Pl. 5,* 1925.

Producing a pruriginous, desquamative lesion on the foot of a young Brazilian recently arrived in France.

Aleurospores 5-7μ, on simple or compound thyrses; chlamydospores borne in groups, increasing in abundance with the age of the cultures.

Giant colony 8 cm. in diameter, surface powdery, white, central plateau 3 cm., elevated 1.5 cm., finally depressed in center; forms crater; border finally cream color; reverse wine red under crater, rest brown mahogany; no pleomorphism in 6 months. On Sabouraud conservation agar, crater becomes irregularly furrowed.

Trichophyton circumvolutum Sabouraud, Maladies du cuir chevelu **3**: 320, *Fig. 128,* 1910.

Circinate lesions of the buttocks, 3-4 cm. in diameter, erythematous with adherent scales on man in Dahomey. His little daughter with tinea tonsurans, *Malmstenia* type at multiple points, cold evolution.

Colonies heaped (suggesting *Achorion*), cerebriform when young, crackled when old.

Unfortunately not fully described, perhaps referable to *Favotrichophyton* along with *F. violaceum.* So many species of dermatophytes from Central Africa have been poorly described that only the cultivation of a large series of cases in those regions will make possible future identification or indicate probable synonymy. Fortunately, to aid in this work, figures of most of the giant colonies exist.

Trichophyton areolatum Negroni, Ann. Parasitol. Hum. Comp. **7**: 438-443, 1929.

From a case of tinea tonsurans in a small child, microscopic preparations of the hairs showed a typical endothrix organism. Argentina.

Giant colony on Sabouraud glucose 4 cm. in a month, acuminate, divided into two portions by a circular furrow, the inner portion dirty reddish purple, the inner zone outside the furrow raised and red, then a white zone, then a moist dirty white zone with the outermost zone indefinite, radiating actively growing hyphae. Also separated into areoles by radiating furrows, often cracked toward the center. On Sabouraud conservation agar the colonies are brownish red, moist, and shining, with acuminate center crowned with a tuft of spines, about a dozen radiating furrows. Colonies soon become pleomorphic in contrast to *T. Sabouraudi*. Only aleurospores produced.

Trichophyton cineraceum Americo da Veiga, Brasil Med. **43**: 837, 1929.

Produced tinea tonsurans and alopecia in Portuguese man in Brazil.

Colony umbonate, dark ashy, surrounded by a darker furrow, then a zone of dull cinereous and a white margin, reverse black. Group of *T. umbonatum* [*T. acuminatum* ?].

Trichophyton acutulum Americo da Veiga, Brasil Med. **43**: 837, 838, 1929.

Produced tinea tonsurans on a Greek recently arrived in Brazil. Patient claimed to have had this condition before leaving Greece.

Spores large, 5μ, endothrix.

Colonies white, circular, with an acuminate center suggesting *T. Sabouraudi,* subcultures yellower and more filamentous.

Trichophyton Sabouraudi Blanchard in Bouchard, Traité Path. Gén. **2**: 907, 908, 1896.

Trichophyton à cultures acuminées Sabouraud, Trichophyties Hum. 173, 1894.

Trichophyton acuminatum Bodin, Champ. Paras. Homme 110-112, 1902.

Aleurosporia acuminata Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Trichophyton (*Aleurosporia*) *acuminatum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

One of the common organisms of tinea tonsurans, found in about 20% of the cases at Paris (Sabouraud's statistics), is apparently quite widespread in Europe. Inoculable into guinea pigs but lesions heal spontaneously. For clinical differentiation from lesions of *Malmstenia* type, see p. 445.

Lateral aleurospores in irregular thyrses; also swellings on the hyphae, suggesting young chlamydospores, often seen (Bruhns & Alexander 1928).

Colony at first a small hemispheric mass with several long, slender coremia which persist but become less conspicuous in age; soon powdery white, then cream white, becoming brownish, sometimes with a violet tint, becoming a flattened cone with radiating furrows of various depths with a thin flat margin; on conservation agar furrows less pronounced, surface glabrous, almost humid and yellowish, growth rather slow, not more than 3.5 cm. in 40 or 50 days under optimum conditions. Pleomorphism very rare, reported in a single culture by Catanei (1931).

Var. **pilosum** Dodge, n. var.

Trichophyton pilosum Sabouraud, Maladies du cuir chevelu **3**: 313, 1910.

Similar clinically, morphologically, and in animal inoculation to *T. Sabouraudi.* North Italy, reported also from Mexico (Gonzales Urueña 1932).

Colony covered with a short dense velvet instead of the rose brown powder of the species. This difference has remained constant in culture.

Trichophyton soudanense Joyeux, C. R. Soc. Biol. **72**: 15, 16, 1912; Arch. de Parasitol. **16**: 449-460, *Pl. 7, Figs. 1-6,* 1914.

Trichophyton sudanense Bruhns & Alexander in Jadassohn, Handbuch Haut- Geschlechtskrankh. **11**: 155, 156, 1928.

Producing tinea capitis (up to 80% infection of children) in Haute Guinée, rare on the coast. Inoculation of experimental animals negative. Catanei (1933) working with strains from the Sahara succeeded in producing transitory lesions with a few infected hairs in two out of four inoculated guinea pigs and a squamous lesion in a monkey which healed spontaneously in about 2 months. Broken hairs in the scales showed endothrix type of infection.

In hairs, arthrospores cylindric or rounded, $2.8\text{-}4.5 \times 4\mu$; aleurospores in either simple or compound thyrses; arthrospores and chlamydospores abundant; on barley, a few atypical closterospores are produced.

Colony a small apricot yellow peak which grows and becomes irregularly folded; about the ninth day the base expands, radiating in a white mat, with radial folds.

Trichophyton louisianicum Castellani, New Orleans Med. Surg. Jour. **79**: 629, 896-899, 1927, probably is a synonym, representing an American strain of this species brought over to America during the African slave trade, since it appears confined to negroes. It is probably not closely related to *T. sulphureum* as Castellani suggests. Lesions oval, with abundant scaling (a yeast often present in the scales, probably a saprophyte). Occasionally thick moist crusts produced rather than scales.

On acid glucose agar, center white, margin yellowish, submerged portion shows from one to several spots of reddish or brownish red color. Yellow color more marked on glucose peptone agar. On casein digest + 3% agar, submersed growth, reddish or yellowish red. On acid maltose, yellow color may be less marked or even absent. Gelatin agar, growth knobby, almost cerebriform, covered with white velvet, margin yellowish. Glycerol agar, growth white, sometimes tinged yellow. Gelatin slowly liquefied after 3-4 days. No gas with sugars. No closterospores or other spores mentioned, but chlamydospore crudely figured.

Doubtful Species

The following species are either nomina nuda, poorly described or with descriptions which I have been unable to find, owing to poor bibliographic data.

Trichophyton Blanchardi Castellani, Arch. Derm. Syphilis **93**: 32, 1908.

Trichophyton Sabouraudi Castellani, 1905? not Blanchard, 1896.

Atrichophyton Blanchardi Castellani & Chalmers, Man. Trop. Med. ed. 3, 1008, 1009, 1919.

Unable to cultivate, mycelium easily breaking up into arthrospores, cells often banana shape, spores round, not in chains. Isolated from glabrous skin, lesions brown, fine scales and vesicles, no papules, great pruritus. Possibly a *Malassezia.*

Trichophyton epitheliomae Greco, Origine des Tumeurs 375-384, *Figs. 197-202,* 1916.

Oidium epitheliomae Greco, 1910 [? MS name].

Isolated from a nasal abscess. The lesion gradually spread to the adjacent regions of the face as large ulcers, fatal in about 2 years. On rats and mice it produced lesions similar to those produced by *Sporotrichum.*

Mycelium branched, septate, 2μ in diameter, producing terminal chains of 5-6 ovoid spores 2-3μ. The sporiferous hyphae are often branched and bear chains on the lateral branches. Coremia of sterile hyphae common. On solid media, arthrospores common in moniliform chains about 4μ in diameter.

On simple agar, colonies whitish, radiating from a grayish point, becoming dull white, margin of fine adherent rays, finally covered with a light chestnut powder. On Sabouraud agar, growth similar to preceding but more luxuriant, undulating, dull straw white, the medium becoming straw-yellow. Marginal rays filamentous. Coremia present. On carrot, and potato, colonies radiate, white or grayish white, with aerial hyphae, which tend to form a uniform layer over the colonies, with a yellowish color in the depths. On simple broth and glycerol broth, colony forms a dull white pellicle, covered with a dull grayish white powder.

While this is too poorly described to place definitely, it apparently belongs either in *Zymonema* or in *Proteomyces.* It is certainly not a species of *Trichophyton.*

Trichophyton lileum Kawasaki, 1923.

Trichophyton inflatum Fiocco & Minassian apud Fiocco, Giorn. Ital. Mal. Ven. Pelle **51**: 189, 1910; Sabouraud, Maladies du cuir chevelu **3**: 581, 1910.

Colony cerebriform, powdery, crackled, center inflated, whitish.

Perhaps near *T. fumatum.*

Trichophyton spongoides Fiocco & Minassian apud Fiocco, Giorn. Ital. Mal. Ven. Pelle **51**: 190, 1910; Sabouraud, Maladies du cuir chevelu **3**: 581, 1910.

Colony bister, neutral, not powdery, center elevated, suggesting a brown sponge placed on a powdery, crackled disc.

Trichophyton carateum Brumpt, Précis Parasitol., 1913; Neveu-Lemaire, Précis Parasitol. Hum. 56, 1921.

Trichophyton sp. Darier, Ann. Derm. Syphiligr. V, **1**: 2, 3, 1910.

MICROSPORUM

Microsporum Gruby, C. R. Acad. Sci. Paris **17**: 301-303, 1843.

Sabouraudites Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 326-329, 1923 (pro parte majore).

Closterosporia Grigorakis (pro parte majore), Ann. Sci. Nat. Bot. X, **7**: 411, 1925.

Type species: *Microsporum Audouini* Gruby. Type of *Sabouraudites* and *Closterosporia* is *Microsporum lanosum* Sabouraud.

Closterospores present, rare in a few species; chlamydospores present; aleurospores rare; in lesions, hair surrounded by a sheath of small arthrospores irregularly arranged, never in chains as in *Ectotrichophyton;* hair breaks several millimeters above the scalp.

The genus is easily separable into three well-defined subgenera: *Neomicrosporum,* for the species with a wide range of hosts, usually found on domestic animals but inoculable to man causing inflammatory lesions; *Kambayashia* for species producing tinea capitis microsporica with some inflammation and confined to the yellow race; and *Eumicrosporum* for species with greater adaptation to a single host, usually the white race of man. For further differences, see key, below. If the genus should be split at some future time, *Sabouraudites* must be used for the section *Neomicrosporum* and *Microsporum* for the section *Eumicrosporum.* For further discussion of lesions, see p. 444, for phylogeny, see p. 461.

Key to Microsporum

Closterospores abundant, growth rapid, pleomorphism usually present, all ages of hosts attacked, not only in the scalp but on the glabrous skin, producing inflammation and sycosis (or even kerïon by *M. felineum*); in domestic animals involving the hairy areas; easily inoculable into guinea pigs. NEOMICROSPORUM.

Colony reddish, closterospores poorly developed on Equidae, very rare and atypical on man.

Colony wine red, crateriform, both concentric and radial folds outside the crater; reverse wine red with a yellowish margin; pleomorphism not noted; France.
M. rubrum.

Colony reddish ochre, nearly glabrous, center a slight folded crater with numerous radial folds not elevated above the general level of the medium, a yellow pigment spreading over the surface of the medium; on potato, yellow or brown closterospores, 25-35 × 18-20μ, 1-4-celled; Europe, Java, Uruguay.
M. equinum.

Colony yellow then vermilion, finally pleomorphic; closterospores not described, aleurospores abundant; disseminated folliculitis in boy of 14, Brazil.
M. Ramosii.

Colony brownish or buff.

Disc woolly or powdery, not glabrous.

Colony chamois, slight central crater with numerous radial folds; reverse chamois with a line of deeper color connecting the outer ends of the rays, the margin lighter; on conservation agar, reverse yellowish with a rose colored zone just inside the margin; on mule, Algeria.
M. marginatum.

Colony light brown, center plane, powdery, with radial furrows surrounded by a zone of velvety hills, the higher next the center and lower near the margin; on conservation agar central disc elevated and deeply umbilicate, silky; on potato, velvet scarcely visible, medium darkening; on man, probably contracted from Bovidae, Belgium.
M. villosum.

Colony brownish, central umbo surrounded by a powdery zone, sometimes marked by concentric circles; on potato, growth fast, pale brown, ochraceous with short, powdery velvet; closterospores, thin-walled, 40-54 × 12-15μ, 4-6-celled; nodular organs present; on man, Argentina.
M. fulvum.

Disc glabrous, moist on some media; closterospores thick-walled; reddish with a thin white velvet on potato.

Colony with chamois or yellowish tobacco-colored disc and a white margin; colony flat without folding or elevation, on cat and man, widespread.
M. felineum.

Colony similar but the lighter colored disc is slightly elevated, glabrous and powdery, becoming umbilicate, surrounded by a dense woolly zone; margin of immersed rays from which arises a short grayish velvet; closterospores 50-75 × 15-25μ, 5-12-celled spines long, on dog and man, widespread. *M. canis.*

Colony bright yellow or reddish yellow.

Colony reddish yellow, slight central depression and 4-5 radial furrows which disappear; Brazil. *M. flavescens.*

Colony bright yellow, flat, dull, surface granular with marginal rays; pleomorphic colony white with concentric yellowish furrows, margins wavy; on potato dull whitish surface with a flatter marginal zone; sycosis, Germany.
M. xanthodes.

Colony grayish or whitish, rarely with a slight orange or greenish tinge.

Colony gray, flat, zonate; on potato, brownish red; on man, Holland.
M. lanuginosum.

Colony white, center a polygonal umbilicus with a small umbo in the center, surface lanuginous, finally with a slight orange or greenish tinge; on potato, little chromogenesis; on man, Sardinia. *M. tomentosum.*

Colony white, punctiform umbo surrounded by a disc of short, thick velvet divided into 4 sectors by radial furrows, broad margin of fine silky velvet; closterospores 60 × 20μ, up to 10-celled; on man, New York.
M. pubescens.

Colony white, center elevated, woolly disc without furrows; on man, Sicily.
M. felineum var. *niveum.*

Colony some shade of yellow or orange; closterospores and aleurospores rare or absent; lesions intermediate between *Neomicrosporum* and *Eumicrosporum,* usually with some inflammation; not attacking domestic animals, not inoculable, or only with great difficulty, into guinea pig; mostly confined to the yellow race.
KAMBAYASHIA n. subgenus.

Colony citron yellow to yellowish brown, darkening in age, surface smooth, moist, waxy, not folded, marginal rays as in *E. mentagrophytes,* pleomorphic, Japan. *M. aureum.*

Colony deep reddish yellow, sometimes paler, surface folded in center, becoming vermiculate with lanceolate rays, pleomorphic, Japan.
M. ferrugineum.

Colony downy, divided by folds into 8 sectors, deep yellowish brown almost red; remaining grayish on Sabouraud conservation agar; no pleomorphism; Japanese in Holland. *M. orientale.*

Colony straw or citron yellow to yellowish brown, center chocolate brown, moist more or less cerebriform with numerous irregular radial furrows; with marginal rays. *M. japonicum.*

Closterospores rare, slender and abortive, pleomorphism absent or very rare, growth slow, causing tinea capitis before puberty without inflammation, not attacking domestic animals, not inoculable or only with great difficulty inoculable into guinea pig. EUMICROSPORUM.

Colony reddish with coremium formation; lanuginous with numerous radial ridges.

Colony on potato, grayish white becoming intense reddish brown; Northern Italy. *M. iris.*

Colony on potato snow white, ''furry,'' England. *M. iris* var. *Craikii.*

Colony grayish or white, sometimes slightly brownish, never yellowish or orange.

Colony umbonate, a flattened cone at first, finally divided by a few radial furrows; on potato reddish colony, Russia, Hungary. *M. umbonatum.*

Colony with tiny umbo, flat, soon divided by 3-4, rarely 6, radial furrows; on potato gray then reddish brown, smooth, moist, finally forming velvet; world-wide. *M. Audouini.*

Colony thicker, dryer, divided into 5-6 sectors; on potato drier, thicker with velvety tufts; no closterospores observed. var. *velveticum.*

Colony smaller, velvet shorter; closterospores present but degenerate; some spiral mycelium; France, Montreal. var. *tardum.*

Colony slightly powdery, flat disc without furrows; closterospores very rare but less degenerate; chlamydospores common; aleurospores rare. var. *depauperatum.*

Colony similar, mycelium more slender, more submerged; Germany. f. *pertenue.*

NEOMICROSPORUM

Neomicrosporum Sabouraud, Maladies du cuir chevelu, 1910.

Closterospores abundant in most species, chlamydospores present; aleurospores rare; often on several hosts, mostly domestic animals but inoculable to man, causing inflammatory lesions.

Microsporum rubrum Cazalbou, Premier Cong. Internat. Path. Comp. 1912; **2**: 306, 307, 1914.

Microsporic lesions on horse from Cherbourg, France; not reported since original case.

On maltose peptone, circular colonies, glabrous, 5 cm. in 15 days at 25° C., wine red, center with slight puckering surrounded by a raised fold, from which radiate many straight folds to the margin. Part way to the margin, another circular ridge connects these radial ridges and gives rise to intermediate radial ridges; reverse wine red, with a narrow margin of yellowish color. On glucose peptone, colonies grow equally well and are similar, but circular ridges are closer together and central area more folded. On malt (3% maltose), colony somewhat similar, but glabrous and grayish. No pleomorphism noted.

Microsporum equinum (Delacroix & Bodin) Guéguen, Champ. Paras. Homme Anim. 144, 1904.

Microsporum Audouini var. *equinum* Delacroix & Bodin apud Bodin, Les teignes tondantes du cheval . . . Thèse, Paris 41-47, 1896; Arch. de Parasitol. **1**: 379-409, *2 pls.*, 1898.

Fusarium equinum Növgaard, Sci. n. s. **14**: 11, 898, 899, 1901.

Sabouraudites (*Closteramma*) *equinus* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Produces tinea tonsurans on horse, rarely on man, usually heals spontaneously on the latter. Not inoculable into guinea pig while culture remains glabrous, and very old cultures lose their virulence. Denmark, France, and North Italy, also Java and Uruguay.

Arthrospores on hair 2-3μ, spherical or somewhat polyhedral from pressure; hyphae in hair 2-2.5μ, parallel to the long axis of the hair. Comparatively few, poorly developed closterospores, 25-35 × 18-20μ, only 1-4-celled; aleurospores, arthrospores, and chlamydospores present.

Colony nearly glabrous, scarcely velvety, almost humid, with deep radial folds, somewhat cerebriform in center, not rising above the general level of the medium. On malt agar, wholly glabrous, reddish ochre, center slightly elevated and folds extremely regular, following the rays; yellow or more or less brownish. Aging cultures covered with a light, white velvet, subcultures much more velvety than the primary one.

Microsporum Ramosii Parreiras Horta (orthog. mutat.).

Microsporum Ramos Parreiras Horta, Brasil Med. **38**: 59, 60, 1924.

Producing disseminated folliculitis in a 14-year-old boy, Brazil.

Aleurospores abundant, closterospores not reported.

On Sabouraud agar with sucrose, colony yellow, then vermilion, finally with white pleomorphic velvet.

Dedicated to João Ramos e Silva. The author suggests that it is very close to *M. equinum*. It should be studied further for a possible relationship to the subgenus *Kambayashia*.

Microsporum marginatum Cazalbou, Premier Cong. Internat. Path. Comp. 1912, **2**: 307, 308, 1914.

Producing lesions on mule from Algeria; not reported since original case.

Mycelium regular, developing racquet mycelium, closterospores and thyrses of aleurospores.

On maltose peptone, colony circular, slight central crater from the outer slope of which radiate a large number of rays. Upper surface and reverse, the color of chamois skin with a line of deeper color connecting the outer ends of the rays, margin lighter. Silky velvet above, inconspicuous. On glucose peptone, equal development, fewer rays and shorter, yellowish below a subperipheral zone, rose color, 4-5 mm. broad. On malt extract (3% maltose), colonies less vigorous, glabrous, central area blackish, the rest grayish, margins sinuous.

Microsporum villosum Minne, Soc. Belge Derm. **7**: 1906, 1907; Kong. Deutsch. Derm. Ges. **10**: 447, 1908; Sabouraud, Maladies du cuir chevelu **3**: 242, 243, 1910.

Sabouraudites villosus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Producing tinea tonsurans microsporica, lesions irregular and indefinite in outline, pityriasis very marked, some lesions of neck and face, probably also on Bovidae; Belgium and Rome, Italy. Inoculable to guinea pig, where the hair is invaded in 10-12 days and heals spontaneously in a month.

Closterospores abundant, 2-8-celled, very thick-walled; arthrospores and hyphae with branching suggestive of stag horns also present.

Colony 6 cm. in diameter, center plane, powdery, grayish yellow, light brown with 3-10 radial furrows; next a zone, about 1 cm. wide, of small velvety hills, higher next the center, lower toward the margin, which is composed of fine, immersed hyphae. Pleomorphism in 4 weeks. On Sabouraud conservation agar, the fine silky disc is cut by radial folds, with a large central umbilicus slightly irregular and quite deep. On potato purée, yellowish, becoming brown, growth very fine, scarcely visible. On purée of carrot, white velvety margin deeply incised surface of irregular elevations and depressions.

Microsporum fulvum Uriburu, Argentina Méd. 1909; Sabouraud, Maladies du cuir chevelu **3**: 241, 242, 1910.

Sabouraudites (*Closteramma*) *fulvus* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Closterosporia fulva Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (*Closterosporia*) *fulvum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing tinea tonsurans microsporica in Buenos Aires, Argentina. Reported common in Argentina, probably also in Uruguay and Brazil. It seems quite probable that reports from Budapest, Hungary, Mainz in Germany, Montreal in Canada, and from New York belong to *M. felineum.*

Closterospores very abundant, thin-walled, 4-6-celled, often in groups of 12-15 on a single pedicel, 40-54 × 12-15μ. Nodular organs and racquet mycelium present; chlamydospores, aleurospores, and arthrospores present in repeated subcultures.

Colony with central umbo, surrounded by a powdery brownish zone often more or less marked by concentric circles with a margin of cottony fringe. On potato, grows very fast as irregular colony, pale brown ochraceous, with a short powdery velvet.

From the descriptions furnished by various authors, it seems probable that *M. felineum* has been confused frequently with this species.

Microsporum felineum Fox & Blaxall, Brit. Jour. Derm. Syphilis **10**: 354, 1896; Sabouraud, Maladies du cuir chevelu **3**: 229-233, 1910.

Closterosporia felinea Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (*Closterosporia*) *felinea* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

? *Microsporum radiatum* Thomson, Brit. Jour. Derm. Syphilis **37**: 269, 270, 1925.

While this species may occur on the scalp, it seems to prefer the glabrous skin in man, even producing kerions. On the cat, numerous large, glabrous crusted areas appear, accompanied by pruritus and apparently spread by scratching. Inoculation into cat, dog, and guinea pig positive. Common in England, Belgium, Northern Italy, rare in Budapest, Australia, New York, and Canada. Reports from the states of Rio de Janeiro, Minas Geraes and São Paulo in Brazil, from Uruguay and from Argentina should probably be referred to *M. fulvum.*

Closterospores as in *M. canis*, but slightly smaller, 8-10-celled; chlamydospores 4-7μ; pectinate hyphae and compound thyrses of aleurospores present.

Colonies regular flat discs without foldings or elevations except the small central button, grayish velvety, soon covered with a chamois or yellowish tobacco (Havana) color at the disc; margin white, of fine radiations. Pleomorphism covers the colony with a white velvet. Grows on potato, with a thin white velvet.

From Ballagi's description of his *M. fulvum* (central umbo surrounded by a rust brown zone, often with concentric circles, margin woolly, white; on potato, colony fox red), it seems likely that his cultures should be referred to *M. felineum.*

Var. **niveum** (Truffi) Dodge, n. comb.

Microsporum tomentosum var. *niveum* Truffi, Arch. Ital. Derm. Sifiligr. Venereol. **1**: 197-202, 1925.

Microsporum niveum Caruso, Giorn. Ital. Derm. Sifilol. **67**: 278-280, 1926.

From kerions, Sicily. Animal inoculation produced acute inflammations.

Closterospores with numerous cells, aleurospores and pectinate organs present.

On Sabouraud, maltose, or glucose agar and on honey agar with glucose, colony 6 cm. in 2 weeks, white woolly central zone elevated, without sulcations.

Microsporum canis Bodin in Guéguen, Champ. Paras. Homme Anim. 144, 1904; Nicolas & Lacomme, Ann. Derm. Syphiligr. IV, **7**: 321-326, *Pls. 2, 3,* 1906.

Trichophyton tonsurans Friedberger, Arch. Wiss. Prakt. Thierheilk. **2**: 369-400, *Pl. 3,* 1876, non aliorum.

Microsporum sp. Bodin & Almy, Recueil Méd. Vét. III, **4**: 161-183, *Pl. 1,* 1897.

Microsporum lanosum Sabouraud, Ann. Derm. Syphiligr. IV, **8**: 172-183, 225-245, *Figs. 1-12,* 1907.

Microsporum caninum Sabouraud, Ann. Derm. Syphiligr. IV, **9**: 153-156, 1908.

Sabouraudites (Closteramma) lanosus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Sabouraudites felineus Langeron & Milochevitch, Ann. Parasitol. Hum. Comp. **8**: 491, 492, 1930 (pro parte).

Closterosporia lanosa Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (Closterosporia) lanosum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Microsporum Audouini var. *macrosporium* Craik, Brit. Med. Jour. 1: 672, 673, 1921.

Producing tinea tonsurans microsporica and herpes circinatus in both children and adults. Originally described from the dog, where it produces dry, scaly lesions without vesicles or pustules; spontaneous inoculation very frequent among experimental animals and experimental inoculation easy, either by implanting infected hairs or from cultures. The guinea pig is the animal of choice. Pleomorphic strains variable in virulence, the older strains inoculable with difficulty or not at all. Very common in Tomsk, Siberia, Western Russia, Bessarabia, Southern Hungary (on the right bank of the Danube, not in Szeged), St. Gall, Switzerland; occasional or rare in Northern Italy, Bavaria, France, Montreal, Canada, Boston, Mass., São Paulo, Brazil, Buenos Aires, Argentina, and Australia.

Closterospores abundant, several celled, 5-7 (–12) celled, 50-75 × 15-25μ, central cells broader than long, those toward the end isodiametric or longer than broad, very thick-walled, cutinized and covered with long asperities. Chlamydospores intercalary, aleurospores occasional, pectinate hyphae present.

Colony similar to *M. Audouini* at first, but more velvety and growth more rapid, with a glabrous and powdery central area as in *M. felineum;* then forming a loosely woven zone about the center (even more conspicuous on wort agar). At 25 days, the center is umbilicate, the woolly layer elevated about 4 mm. and 1 cm. wide, remaining snow white when old; margin with immersed rays, from which rises a short grayish velvet; colony, 9-10 cm. in diameter. On Sabouraud glucose agar, the woolly portion is irregular and the immersed rays are yellowish. On Grütz agar, center and reverse reddish, sometimes with concentric rings; on peptone, woolly, with more or less concentric rings, bluish brown. On potato, colony at first yellowish then reddish brown, smooth, finally covered with a white velvet which masks the red color, suggesting *M. Audouini* but double the size. On Pollacci agar, similar to that on Sabouraud maltose agar but more yellow. On gelatin, growth slow, velvety, liquefaction only after 3 weeks or a month. Pleomorphism may develop as a white circular disc of velvet or a radiating plaque immersed in the medium with the surface smooth, humid, and brownish, or the colony may be rough with coarse echinulate tufts, the humid form being the least stable.

Microsporum flavescens Horta, Mem. Inst. Oswaldo Cruz 3: 301-308, *Pl. 17,* 1912.

Sabouraudites flavescens Ota & Langeron, Ann. Parasitol. Hum. Comp. 1: 327, 1923.

Producing tinea capitis microsporica in children, Brazil.

Very close in microscopic characters to *M. canis* and especially to *M. fulvum.*

On Sabouraud agar, growth rapid, reaching 4 cm. in 2 weeks, with slight central depression and 4-5 furrows, which may disappear, reddish yellow. Pleomorphism beginning in about 2 weeks. Cultural characters also given for carrot, potato, etc., which are not strikingly different.

Microsporum xanthodes Fisher, Derm. Woch. **66**: 241-247, *3 figs.*, 1918.

Sabouraudites (*Aleurocloster*) *xanthodes* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Producing deep-seated sycosis in beard of an artillery man, Germany.

Closterospores abundant, 4-8-celled; aleurospores lateral; racquet mycelium and chlamydospores occasional.

Growth rapid, bright yellow, dull, flat colony with granular surface and marginal rays becoming 8 cm. in 3 weeks; pleomorphic colony white, 8.5 cm. in diameter in 3 weeks, margin wavy, surface with shallow, concentric yellowish furrows. On peptone agar, growth rapid, yellowish white with smooth concentric zones and no rays. On potato, dull whitish, with a flatter marginal zone. On Grütz agar, colony resembles that of *Achorion gypseum* (see p. __?, Bruhns & Alexander 1928).

Microsporum lanuginosum Muijs, Nederl. Tijdschr. Geneesk. **62**: 1497-1509, *5 figs.*, 1918.

Producing typical tinea capitis microsporica in Holland. Not inoculable to guinea pig.

Racquet mycelium hyphae undulate, often in knots suggesting nodular organs. Chlamydospores present. Aleurospores and denticulate hyphae also present.

Colony gray white, flat, zonate. On potato, colony brownish red. Some pleomorphism on Sabouraud and glucose agar.

Microsporum tomentosum Pelagatti in Sabouraud, Maladies du cuir chevelu **3**: 241, 1910.

Microsporum sp. Pelagatti, Giorn. Ital. Mal. Ven. Pelle **51**: 254, 255, 1910

Producing tinea tonsurans microsporica, originally reported from Sassari Sardinia, and later from Sicily.

Closterospores pluriseptate, abundant; occasionally aleurospores, clavate hyphal tips and chlamydospores present.

Colony having a polygonal umbilicus with a tiny umbo in the middle, white, surface lanuginous, with a slight orange or greenish tinge; divided into sectors, 6 cm. in diameter in 25 days.

Microsporum pubescens Sabouraud, Maladies du cuir chevelu **3**: 243-245, 1910.

Sabouraudites pubescens Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Closterosporia pubescens, Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (*Closterosporia*) *pubescens* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing tinea tonsurans microsporica on a child from New York City in France. Original case was of long standing and showed no inflammation. Also reported from Genoa and Rome, Italy. On guinea pig, lesion develops promptly in 10 days, then heals very slowly, hair falling in 55 days.

Closterospores 60 × 20μ, up to 10-celled; aleurospores and racquet mycelium present.

Colony with central punctiform umbo, surrounded by a small white zone of short, compact velvet divided by radial furrows into 3-4 sectors; margin broad, fine silky velvet. At one month, 6 cm. in diameter with the furrows nearly obliterated, pleomorphism already evident. On Sabouraud's conservation agar, colony similar to that of *M. villosum*.

KAMBAYASHIA

Kambayashia Dodge, subgen. nov.

Closterosporae rarae vel nullae, degeneratae; chlamydosporae abundantes, evolutae; aleurosporae rarae, atypicae; ex tinea capitis microsporica trichophytica cum inflammatione in nationibus flavis.

Closterospores rare or absent, not well differentiated; chlamydospores abundant and apparently retaining traces of sexuality; aleurospores rare and not very typical; in the present state of our knowledge confined to man and to the yellow race; lesions predominantly tinea capitis microsporica, but more inflammatory types present on the glabrous skin, intermediate in this respect between *Neomicrosporum* and *Eumicrosporum*.

Microsporum ferrugineum Ota, Jap. Jour. Derm. Urol. **21**: 201, 330, 1921; Bull. Soc. Path. Exot. **15**: 588-594, *Figs. 1-3*, 1922.

Grubyella ferruginea Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Achorion (*Grubyella*) *ferrugineum* Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Trichophyton ferrugineum Langeron & Milochevitch apud Talice, Ann. Parasitol. Hum. Comp. **9**: 77-86, *3 figs.*, 1931.

Producing tinea tonsurans microsporica of children in Japan; also reported from lesions of the glabrous skin and from eczema marginatum. Not inoculable into guinea pigs. Reported as very common in Japan and Manchuria.

In the hair, mycelium 2.5-3μ in diameter, straight and vertical with little interweaving; septa not seen, arthrospores 2.3-3μ, not in chains, walls thick. In scales, hyphae undulate, sometimes in sigmoid curves, frequently branching dichotomously with lateral protuberances; septa rare. In cultures, chlamydospores large, 30μ in diameter, intercalary or terminal (Fig. 87); pectinate hyphae present but not abundant, aleurospores and closterospores not observed.

Colony deep reddish yellow, sometimes paler. On malt infusion, more humid, after 7-8 days, powdery sulphur colored, becoming either flat with distinct lanceolate rays and with folded center, or vermiculate and folded as in *Achorion Schoenleini,* 4-5 cm. in diameter. On potato, irregularly acuminate, straw color or ochraceous. On Grütz agar, bright chocolate brown. On Pollacci agar, more folded and yellower than on other media, center white, powdery, surface dry. On peptone agar, similar to colonies on Sabouraud agar, but only half the size, center rust-brown, surrounded by a yellowish zone and a grayish white margin, powdery.

In the literature available to me, there seems to be very little to separate the following species of this subgenus (except *M. orientale*) from *M. ferrugineum;* but in the absence of access to the early literature, I have not attempted to reduce them to synonymy. If the references which I have not seen are correctly quoted, probably *M. ferrugineum* is the oldest name and should be used, although *M. japonicum* was probably proposed only one or two months later. Regardless of the name used, each author insists that his organism is the commonest dermatophyte in Japan and adjacent regions.

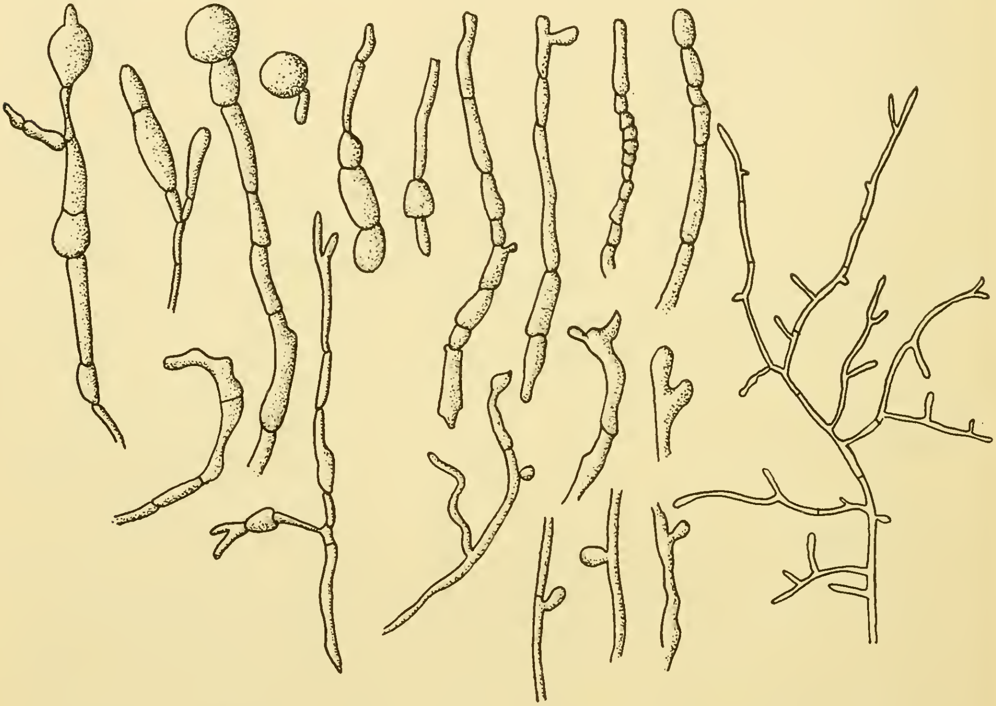

Fig. 87.—*Microsporum ferrugineum.* (After Langeron & Milochevitch 1931.)

As more data become available I suspect that this group will be found to have originated in Mongolia and Turkestan among the nomads in close association with the horse. It seems most closely related to *M. equinum,* and probably represents a relatively recent adaptation to man in which variation is still abundant and degeneration of sexual processes has begun along with increasing specialization to one host. This degeneration also seems to have begun in *M. equinum,* but too little cytologic and morphologic work has been done in either group to warrant very definite statements.

Microsporum japonicum Dohi & Kambayashi, Jap. Jour. Derm. Urol. **21**: 433, 1921.

Microsporum sp. Kambayashi, Jap. Zeitschr. Derm. Urol. **19**: 491, 1919.

Producing tinea capitis microsporica in Japan; also isolated occasionally from cases of trichophytia maculosa and kerion Celsi. [Literature unknown to me earlier than Kambayashi (1932) which does not mention pathogenicity.]

In cultures, hyphae straight or undulate, branching dichotomous, 2-3.5μ in diameter; aleurospores rare, 2-3.5μ, ovoid or pyriform; closterospores 3-4 locular, rare, degenerate, and not well differentiated; chlamydospores abundant, terminal, or intercalary, usually ovoid, variable in size from 4-19μ; arthrospores in very old cultures as also forms suggesting short favic candelabra and other densely branching aggregates.

The interpretation of the possible sexual state figured by Kambayashi (1932) is extremely difficult. A terminal cell suggesting a young chlamydospore is apparently the female organ. The penultimate cell grows out as a branch, suggesting an antheridium, which grows up the side and fuses with the female cell at the tip. In other cases the penultimate cell is said to invade the terminal cell, which degenerates, and to produce a coil of cells within the wall of the terminal cell. Asci spherical, containing 2-12 spores. Should the coil of cells within the ascogonial wall be considered as an ascogenous hypha which invades the old ascogonium and produces a chain of asci, or are these coils really outside the old ascogonial wall and represent the beginnings of perithecia as in other Gymnoascaceae? Or is it a wholly asexual phenomenon in which a terminal chlamydospore dies and is invaded by a living cell just below? While the number of spores within the ascus varies from 2-12, the nuclear content seems to be in multiples of 8 and evidently the other nuclei degenerate during spore formation.

On Sabouraud maltose agar, growth very slow, colonies punctiform, hemispheric, straw to citron yellow becoming knotted, elevated, and only 3-4 mm. in diameter after 86 days, with delicate arborescent yellowish growths into the medium. Another type of colony on the same medium produced by other strains has faster growth, becoming 6 mm. in 40 days, colony flat, with a slightly elevated brownish yellow to chocolate brown center and a surface with irregular, more or less radial furrows, dry, brownish yellow with a reddish tone, and with yellowish arborescent outgrowths into the medium at the flat margins. Later both types become identical in their giant colonies which are 3.5-5 cm. in 40 days, center brownish yellow to chocolate brown, moist, more or less cerebriform with very numerous, very irregular, radial folds, the color mostly straw yellow to brownish yellow, the reddish tone being stronger toward the center and lighter toward the margin which is almost white with yellowish arborescences into the medium.

Microsporum aureum Takeya, Tohoku Jour. Exp. Med. 6: 80-93, 1925.

Producing tinea tonsurans microsporica in Japan (isolated in 97% of Takeya's cases). Not inoculable into guinea pig.

Hyphae 2-3μ in diameter; chlamydospores 6-8μ; aleurospores rare.

Colony at one month 2-3 cm. in diameter, citron yellow to yellowish brown, darkening in age, surface smooth, moist, waxy, shining, never powdery or velvety, not folded, marginal rays suggesting *Ectotrichophyton mentagrophytes*

(*Trichophyton gypseum* var. *asteroides*) or its var. *radiolatum* (*T. radiolatum*). Polymorphism of two aspects: either the inner half of the colony spherical, warty or radially furrowed, suggesting a chrysanthemum, surface moist, shining, yellowish brown or citron yellow, or surface velvety white, reverse yellowish. On 3% peptone agar, growth weaker, color brighter, colony folded or knotted as in the first type.

Microsporum orientale Carol. Urol. Cutan. Rev. **32**: 22, 23, *Fig. 8,* 1928.

Microsporum ferrugineum var. Kurotchkin & Chung, Nat. Med. Jour. China **16**: 174-176, *Figs. 3, 5,* 1930.

Producing tinea capitis on a Japanese boy in Holland.

Racquet mycelium and intercalary chlamydospores present; no closterospores or aleurospores observed.

Colonies downy, divided by 4 radial folds, later by 8 folds, deep yellowish brown, almost red, 4-5 cm. in diameter; no pleomorphism. On Sabouraud conservation agar, colony grayish.

EUMICROSPORUM

Eumicrosporum Sabouraud, Maladies du cuir chevelu **3**: 1910.

Closterospores rare, slender and abortive, growth slow, pleomorphism absent or very rare; producing tinea capitis microsporica before puberty without inflammation, not attacking domestic animals, not inoculable, or only with very great difficulty inoculable, into the guinea pig.

Microsporum iris Pasini, Giorn. Ital. Mal. Ven. Pelle **52**: 613-636, *Pls. 1-5 bis,* 1911.

Sabouraudites (*Aleuramma*) *iris* Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Infecting epidermis and hair follicles. Milan and Como, Northern Italy. Inoculable into guinea pigs.

Aleurospores about 3μ in diameter, or 3-4 × 2-3μ; chlamydospores and denticulate organs present; closterospores 1-celled.

At 26° C., a small white downy tuft, 2-3 mm. in diameter, spreading to a downy white disc with a brick red iris or cockscomb, with 8-12 radial folds, attaining a diameter of 4-5 cm. in 25 days. On Sabouraud glucose agar, the brick red color less developed and the iris color appearing more slowly. On mannite agar, growth slower but otherwise similar. On broth agar, with or without glycerol, milky white finally with a slight reddish pigment. On potato, grayish white becoming intense reddish brown. Pleomorphism in one month.

Var. **Craikii** Dodge, n. nom.

Verticellium depauperatum Bruhns & Alexander in Jadassohn, Handbuch Haut- Geschlechtskrankh. **11**: 129, 1928.

Microsporum sp. Craik, Brit. Med. Jour. **1**: 672, 673, 1921.

Producing ringworm of the scalp, face, and neck of a thirteen-year-old boy, England.

Mycelium branching, septate, hyaline, 2-3μ in diameter with pyriform swellings at the septa, with arthrospores; thyrses of aleurospores united into coremia, aleurospores 2-3μ; chlamydospores rare, arising by septation at the swellings of the hyphae; closterospores 1- or 2-celled, rough, 15-30 × 6-8μ.

Colonies on wort agar, round, pinkish, elevated at the center, umbilicate with numerous fine radial folds; coremia form in about a week. On potato, snow white and furry, without folds. On neutral malt extract gelatin, growth as in potato, medium liquefied in 2 weeks.

Microsporum umbonatum Sabouraud, Ann. Derm. Syphiligr. IV, **8**: 173, 1907; Maladies du cuir chevelu **3**: 171, 172, 1910.

Sabouraudites (Aleurocloster) umbonatus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Closteroaleurosporia umbonata Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (Closteroaleurosporia) umbonatum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing tinea tonsurans microsporica on two Russian children, recently arrived in France; also reported from Hungary. Not inoculable to guinea pig.

No closterospores; a few compound thyrses of aleurospores; also mycelial swellings with short branches bearing spores (aleurospores?) many pectinate and denticulate organs present.

Colony a central conical umbo with very fine white rays; becoming divided into sectors by furrows, giving the appearance of a flower. On potato, after 23 days, producing small white points along a reddish streak.

Miorosporum Audouini Gruby, C. R. Acad. Sci. **17**: 301-303, 1843.

Trichophyton decalvans Malmsten, Arch. Anat. Physiol. Wiss. Med. **1848**: 1-19, 1848.

Trichomyces decalvans Malmsten, Arch. Anat. Physiol. Wiss. Med. **1848**: 1-19, 1848.

Sporotrichum (Microsporum) Audouini Saccardo, Syll. Fung. **4**: 101, 1886.

Trichophyton microsporum Sabouraud, Ann. Derm. Syphiligr. II, **3**: 1061-1087, *2 pls.*, 1892.

Martensella microspora Vuillemin, Bull. Soc. Myc. France **11**: 97 [footnote], 1895.

Sabouraudites Audouini Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 327, 1923.

Closteroaleurosporia Audouini Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (Closteroaleurosporia) Audouini Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing prepubertal tinea torsurans microsporica and once reported from a case of tinea unguium (Bresciani 1925). Inoculable spontaneously or by infected hairs into guinea pig, not by cultures. Once isolated from a dog, but not the common species on that host. Endemic in England, France, Switzerland, Northern Italy to Rome, and Spain with epidemics occasional in the Rhine valley; since the World War endemic also in Germany, Austria, Hungary, and epidemic in Roumania. Occasional in Boston, Chicago, and Australia; rare in São Paulo, Brazil.

Hyphae either straight or curved with clavate tips; chlamydospores terminal or intercalary, 5-7μ; aleurospores 2-4μ; closterospores rare, usually only 1-2-celled, very rarely up to 10-celled, 40-70 × 15-25μ; rarely short spirals on dextrin + peptone and on wheat flour.

Colony a small velvety disc with a very small point in the center, reaching 5 cm. in a month, white or light grayish (brown at 37° C.); with 3-4 radial furrows, developing up to 10 intercalary radial furrows. After the colony reaches about 8 cm. in diameter, the furrows disappear, and concentric circles of long and short velvet form; practically no pleomorphism present. On potato, gray then reddish brown, smooth, moist, forming a velvet in about 10 days.

Var. **velveticum** (Sabouraud) Dodge, n. comb.

Microsporum velveticum Sabouraud, Ann. Derm. Syphiligr. IV, **8**: 178, 1907; Maladies du cuir chevelu **3**: 170, 171, 1910.

Aleurosporia velvetica Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 413, 1925.

Producing tinea tonsurans microsporica; not inoculable to guinea pigs, rare in Paris where first described; reported common in Louisiana by Castellani.

Only aleurospores in compound thyrses observed.

Colony whiter, drier, and thicker than in the species; in age dividing into 5-6 sectors, remaining cottony but becoming slightly brownish. The older colonies look much less like the species than the younger and maintain this difference for 2 years. On potato, crowded velvety tufts, colony drier and thicker than in *M. Audouini.*

Sabouraud (1910) suggests that this variety may be only a pleomorphic strain of *M. Audouini.*

Var. **tardum** (Sabouraud) Dodge, n. comb.

Microsporum tardum Sabouraud, Maladies du cuir chevlu **3**: 172, 1910.

Sabouraudites tardus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Closteroaleurosporia tarda Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 415, 1925.

Microsporum (Closteroaleurosporia) tardum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Producing tinea tonsurans microsporica; not inoculable into guinea pig; known only from France and Montreal.

Closterospores degenerate; aleurospores 2-3 times as long as they are broad, arthrospores present; degenerate spirals and denticulate and pectinate hyphae present.

Colony appears as a dwarf *M. Audouini,* having half its dimensions, the velvet shorter, drier, and thicker, suggesting a colony on unsuitable medium, but these cultural characters seem constant.

Var. **depauperatum** (Guéguen) Dodge, n. comb.

Microsporum depauperatum Guéguen, Arch. de Parasitol. **14**: 426-446, *Figs. 1-25,* 1911.

Sabouraudites (Aleuramma) depauperatum Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Producing herpes circinatus on thigh. Lesion pruriginous, scaly without vesicles; fatal to white mice, not inoculable into guinea pig or man.

In lesions, hyphae 2-3μ in diameter, constricted at the sparse septa; in culture chlamydospores 40 × 20μ, wall irregularly thickened on ordinary agar; aleurospores rare, pectinate hyphae and racquet mycelium present; closterospores very rare, several celled when present.

Colony a slightly powdery, flat, compact disc. On potato, cottony disc. On gelatin liquefying medium after about 2 weeks.

Forma **pertenue** (Plaut apud Klehmet) Dodge, n. comb.

Microsporum pertenue Plaut apud Klehmet, Deutsch. Med. Woch. **45**: 1188, 1189, 1919.

On glabrous skin, causing occasional epidemics in Germany, not easily inoculable to guinea pig, lesions slight with spontaneous healing. Not inoculable to adult men, but rarely to women (nursing sisters caring for infected children developed slight lesions between the breasts, which healed promptly).

Mycelium 2-3.5μ in diameter, some arthrospores at first, later chlamydospores; aleurospores solitary, rarely in twos and threes.

On Sabouraud maltose agar, colony 4 cm. in diameter in 4 weeks, fine gray strands with center yellowing and finally browning in 2 months when growth ceases; pleomorphism in 4 weeks. On conservation agar, growth similar but slightly faster, pleomorphism(?) in 3 weeks. On gelatin, growth deeper in medium, similar pleomorphism in 3 weeks, liquefaction only after 4 weeks. On Plaut's favus medium [peptone 3%, agar 3%, maltose 2%], colony much better, reverse golden yellow, center slightly elevated, small, surrounded by a furrow, with 5 deep and 10-15 shallow radial furrows.

Doubtful and Excluded Species

Microsporum brachytomum Ono, 1921.

Microsporum anomeon Vidal, Ann. Derm. Syphiligr. II, **3**: 22, 1882, is *Micrococcus* sp. fide Vuillemin, Bull. Soc. Myc. France **11**: 98, 1895.

Microsporum trachomatosum Noiszewski, Gazzetta Lekarska **25**: 998, 1890; Blanchard, Traité Path. Gén. **2**: 925, 1896.

ACHORION

Achorion Remak, Diagnostische u. pathogenetische Untersuchungen 193, *Figs. 5, 6,* 1845 [quoted from Robin, 1853].

Lophophyton Matruchot & Dassonville, Rev. Gén. Bot. **11**: 429-444, *Pls. 18, 19,* 1899.

Grubyella Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Arthrosporia Grigorakis, Ann. Sci. Nat. Bot. X, 7: 414, 1925.

Type species: *Achorion Schoenleini* (Lebert) Remak.

Chlamydospores and aleurospores usually present, sometimes also closterospores, hyphal tips often swollen forming favic candelabra; giant colonies rarely powdery, usually cottony or even moist; lesions usually with typical favic scutula, hair dull grayish, splitting longitudinally, rarely inflammatory on normal host, usually so on occasional hosts.

As in *Microsporum*, we have a degeneration series in this genus. In the first subgenus, which we may call *Lophophyton*, there are a wide range of hosts, more inflammatory lesions, and greater diversity of spore forms in the life cycle. In the subgenus *Euachorion* there is greater host specialization, little or no inflammatory processes, usually only chlamydospores and arthrospores present.

The recent classifications based on morphology of spores have attempted to distribute the section *Lophophyton* between *Microsporum* and *Ectotrichophyton* and have either recognized *Euachorion* (often under another name) as a separate genus, or transferred it to *Favotrichophyton*.

Key to Species

Closterospores and aleurospores present, attacking a variety of domestic animals as well as man and producing typical scutula on several, or if scutula are not produced, lesions are inflammatory. LOPHOPHYTON.

  Colony powdery, café-au-lait in color, margin white.

    Margin of lanceolate rays, cottony; eccentric oval furrow; center a small button, pleomorphic mycelium white; nodular organs present. *A. gypseum.*

    Margin without rays, no oval furrow, center irregularly elevated, reverse golden yellow; pleomorphic colony tinted color of wine lees. *A. Serisei.*

  Colony violaceous; center elevated, margin a rosette of compact hyphae. *A. violaceum.*

  Colony varying from white at room temperature to rose color at 30° C., in some cultures even raspberry; pigment diffusing into the medium; on conservation medium with 3-4 fine concentric folds about a slight central depression. *A. gallinae.*

  Colony pure white with short marginal fringe, rough with more or less concentric furrows with some irregular hills and channels about the margin; reverse yellowish white at room temperature, deep violet at 35° C. *A. muris.*

  Colony dirty white, becoming yellowish, waxy, center elevated, surrounded by a flat waxy zone and margin of submersed rays suggesting cypress leaves, reverse bright yellow. *A. cupressiforme.*

Closterospores absent, usually also aleurospores, usually attacking only one domestic animal or man and rarely producing typical scutula on more than one host, although sometimes inoculable into several hosts, usually lesions not inflammatory; colony usually moist, irregularly folded. EUACHORION.

  Colony bright yellow becoming brownish; favic scutula grayish white; nodular organs present; inoculable to guinea pig not mouse, ape, or hen. *A. formoseum.*

  Colony yellowish white; favic scutula bright yellow; no nodular organs; inoculable to guinea pig, rat, mouse, cat, and rabbit. *A. Schoenleini.*

Colony pure white.
  Colony white cottony, with radial folds fracturing at the center; on canary, inoculable to man (herpetic lesion), not to white mouse. *A. passerinum.*
  Colony cerebriform, reverse brownish gray; finally crateriform; known only from man (position uncertain). *A. niveum.*
  Colony velvety, rarely powdery, red pigment diffusing into medium; on dog, inoculable to mouse and man. *A. caninum.*
  Colony moist at first, showing velvet after 10-12 days, becoming dry powdery, surface irregular, corrugated. *A. africana.*
Colony brown gray to greenish, glabrous, with concentric rings. *A. annulosum.*

Achorion gypseum Bodin, Ann. Derm. Syphiligr. IV, **8**: 585-602, *1 pl.,* 1907

Trichophyton du chien Sabouraud, Trichophyties Hum. 114, 1894.

Sabouraudites (Aleurocloster) gypseus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Closterosporia gypsea Grigorakis, Ann. Sci. Nat. Bot. X, **17**: 415, 1925.

Microsporum (Closterosporia) gypseum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

? Trichophyton gypseum asteroides Souche R.B.S. Biltris, Ann. Inst. Pasteur. **43**: 281-358, *15 figs.*, 1929.

Producing favus with scutula on cat and horse, very rarely on rats, mice, and men; also a scutiform mass on the comb of a rooster. In man, kerion and sycosis or only erythematous scaly lesions are more common. Perhaps most frequent on the horse. Occasional in France, Belgium, Germany, and Austria; rare in Denmark, New York, São Paulo in Brazil, and Buenos Aires in Argentina. Perhaps the case reported by Mewborn (1903) on the scrotum and adjacent thigh and of Biltris (1929) from mice and scaly pruriginous lesions on forearm should be referred here.

On Sabouraud maltose racquet mycelium, aleurospores, and large closterospores are produced. On cereals, spirals and compound thyrses of aleurospores are produced, and the cells of the racquet mycelium are less swollen. On soluble starch or dextrin and peptone, closterospores are very abundant but there is no racquet mycelium. The presence of sodium chloride produces very deformed closterospores. Chlamydospores 8-10μ; aleurospores 3-5 × 2.5-3.5μ, cylindric, with the free end rounded, very caducous; closterospores 6-7-septate, 12-13 × 40-60μ; nodular organs 35-40μ in diameter.

Colonies with a small central button, 3 radial folds and a circle of small mammillae about the periphery; center café-au-lait, marginal zone white at 10 days. At 20 days, lanceolate rays appear at the margins and an eccentric oval furrow, often imperfect, appears; the rays remain cottony while the central portion becomes powdery, often with a small white spot at the center. In a month the pleomorphic velvet resembles the species of *Microsporum* section *Neomicrosporum.* At 37° C. the colony resembles *T. plicatile.* Reverse reported brown in the center with a white margin. On potato, white, velvety, not coloring medium.

Achorion Serisei Cazalbou, Bull. Soc. Path. Exot. **6**: 300-303, *Pl. 5,* 1913.

Isolated from a case of favus on horse in Madagascar, not reported since the original case. Producing dry erythematous lesions without favic scutula on man. Producing favic scutula on guinea pigs.

At the root of the hair the filaments form a fringe, suggestive of *Microsporum,* although short filaments are seen at the surface with groups of arthrospores as in *A. Schoenleini.*

Closterospores abundant, 60 × 12μ, with 4-5, rarely 3, septa.

Colony café-au-lait, margin tomentose and whitish, 3-4 mm., grading imperceptibly into the chalky and granular center, irregular with incomplete radial folds, center irregularly elevated; reverse golden yellow. Pleomorphism irregular, finally becoming tinted like wine lees instead of white as in other species.

Bruhns (1928) reports that this species is very close to *A. gypseum.*

Achorion violaceum Bloch Derm. Zeitschr. **18**: 815-822, *Pls. 10-12,* 1911.

Sabouraudites violaceus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 328, 1923.

Achorion (Bodinia) violaceum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Bodinia violacea Brumpt, Précis Parasitol. ed. 4, 1297, 1927.

Lesions typical *Trichophyton* lesions, superficial or even forming kerion, also with typical scutula; Harry reports one case of favus due to this organism where scutula were not produced. Rare in Switzerland, Germany, Austria, Russia. Perhaps *Trichophyton violaceum* Kusunoki (1913) should be referred here although no scutula were reported. Inoculable to man, guinea pig, and rat, producing scutula.

Closterospores with several cells, and aleurospores on slender mycelium; chlamydospores intercalary, aleurospores and staghorn branching on coarser, irregularly septate mycelium.

Colonies dark red brown violet, becoming lilac and brown; center much elevated, irregularly verrucose, margin a rosette of compact hyphae, pleomorphism variable in time of appearance.

So much variability is reported regarding this organism that it suggests that the different types of lesions may have been produced by two different organisms and that the description of Bloch is a mixture of characters of the two. Several cases have been reported where lesions produced by two different organisms occurred simultaneously on different portions of the body. If the description of Bloch is correct, this organism shows much more variability than any other in this group so far described.

Achorion gallinae (Mégnin) Sabouraud, Maladies du cuir chevelu **3**: 553-569, 1910.

Epidermophyton gallinae Mégnin, C. R. Soc. Biol. **33**: 404-406, 1881; Bull. Soc. Centr. Méd. Vét. **44**: 183-186, 1890.

Trichophyton Megnini Blanchard apud Bouchard, Traité Path. Gén. **2**: 915, 916, 1896 (excl. syn. *T. roseum*).

Lophophyton gallinae Matruchot & Dassonville, Rev. Gén. Bot. **11**: 429-444, 1899.

Sabouraudites (Aleurocloster) gallinae Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 327, 1923.

Closteroaleurosporia gallinae Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 412, 1925.

Normally causing favus about the head of the turkey and domestic fowl, but inoculable into man and rarely occurring spontaneously. The disease was first described by Gerlach (1858-59) and F. Müller (1858). First cultivated by Duclaux (Mégnin 1890) and first thoroughly described culturally by Sabrazès (1893). (See also Costantin & Sabrazès 1893 and Costantin 1893.) Artificial inoculation on man did not produce typical favic lesions, hence this organism was long confused by Sabouraud and others with *Megatrichophyton roseum* which also infects the head of fowl. In badly infected poultry houses the disease sometimes extends to the feathered areas, causing the loss of feathers over the infected areas and leaving scutula. On man, the experimental lesions tend to disappear spontaneously by the seventeenth day, although small scutula are produced. Also inoculable into guinea pigs and white mice. Common in France, occasional in Germany, rare in Brazil.

Clostrospores 1-6-celled, either lateral or terminal, with few aleurospores; spirals on dextrin + peptone agar.

On Sabouraud glucose, small round disc, short velvet, pure white, having a small central button with a small cup. At 30° C., pale rose, umbilicate, with cerebriform convolutions and cracks in age. Divided into sectors by radial folds, rose pigment diffusing into the medium, the only member of this genus in which this is reported. The amount of pigment varies, in some colonies being a deep raspberry color.

On Sabouraud conservation agar, it retains its platelike appearance with a slight concavity and three or four very fine concentric folds. On potato, surface irregular, white, with small cracks or irregular furrows, yellowish in color. On milk, peptonization incomplete with a vermilion floating colony. Readily differentiated from *M. roseum* by its more rapid growth, flatter colony and pigment diffusing into the medium. The latter has a gooseberry violet reverse with a black spot in the center, and the pigment does not diffuse.

Achorion muris (Gluge & d'Ukedem) Dodge, n. comb.

Mycoderma sp. Bennett, London & Edinburgh Monthly Jour. Med. Sci. **2**: 504-519, 1842.

Achorion sp. Draper [Observations sur des sources faveuses, 1854]. Abstracted in Bazin, Leçons sur les affections cutanées parasitaires 119, 1858.

Microsporum muris Gluge & d'Ukedem, Bull. Acad. Roy. Belgique II, **3**: 338-352, *Pls. 1, 2,* 1857; Ann. Méd. Vét. **1858**: 370, 1858.

α-Favuspilz Quincke, Arch. Exp. Path. Pharm. **22**: 62-76, *3 pls.,* 1886.

Sporendonema myophilum Peck, Rept. State (New York) Botanist **41**: 80, 1888.

Oidium Quinckeanum Zopf, Die Pilze 481, 1890.

?Achorion Arloini Busquet, Ann. Micrógr. **3**: 9-21, 62-75, 136-149, *Pls. 2-4*, 1891 (see p. 507 of this book).

Achorion eurythrix Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-92, 1893.

Achorion Quinckeanum Bodin, Arch. de Parasitol **5**: 5-30, 1902.

Malassezia sp. Escomel, Bull. Soc. Path. Exot. **12**: 350-353, 1919.

Malassezia muris Escomel, Bull. Soc. Path. Exot. **17**: 922, 923, 1924.

Sabouraudites (Closteramma) Quinckeanus Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Closteroaleurosporia Quinckeana Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 412, 1925.

Microsporum (Closteroaleurosporia) Quinckeanum Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

This species presents many problems. It is very difficult in the early cases to be sure whether the authors were dealing with accidental inoculations of mice by *A. Schoenleini* or by this organism. Even the descriptions of the early cultures leave us in doubt, but since the lesions on mice are more severe and more common, reaching epizoötic proportions, when caused by this species, it seems quite probable that the early workers, such as Bennett (1842), Draper (1854), Friedrich (1857), Gluge & d'Ukedem (1857), Pieschel & Voigtländer (1857), Zander (1858), and Schrader (1858) were dealing with this species. The statements regarding morphology are extremely contradictory. Quincke, Busquet, Sabouraud, and Grigorakis figure closterospores, Bodin does not mention them, while Langeron & Milochevitch deny that closterospores are produced on any medium.

Producing severe favic lesions on mice, usually attacking the head and largely destroying the skin and the cornea, causing death by starvation, following blindness. Found also on a hedgehog *(hérisson)* which had been employed to rid an infested house of mice. Easily inoculable into man, in whom the lesions are usually confined to the glabrous skin, usually with few favic crusts, so that the human lesion might be diagnosed as herpes circinatus. Microscopically indistinguishable from *Achorion Schoenleini* in the tissues. Inoculable into guinea pig, producing either favic scutula or dry scaly lesions which heal spontaneously. Common in Germany, occasional in England, Austria, and Hungary, rare in France.

In hair, hyphae 1.5-2μ in diameter, arthrospores 3-6μ in diameter. In cultures closterospores septate, walls thick, 40-70μ, 4-7-celled (3-6 septate); chlamydospores 7-10μ, rarely up to 15μ; aleurospores 4-5μ, borne on compound thyrses. Langeron & Milochevitch report spirals on straw and dung.

Colony a pure white disc resembling pleomorphic colonies even in the primary colony, with a short marginal fringe, becoming rough, with more or less concentric furrows, with some irregular hills and channels around the margin; reverse yellowish white at room temperature, deep violet at 35° C. On malt agar (3% maltose and 3% carbohydrates, expressed as glucose), colony more sharply folded, approaching cerebriform. On glycerol peptone agar, intermediate between that on malt agar and on Sabouraud glucose agar. On beef broth, forming white islets, light yellow below with some grayish flocci on the liquid. Gelatin liquefied; milk casein clotted then liquefied, colony white, floating. On potato, a fine short, white velvet, with short irregular folds and furrow; growth mediocre.

The resemblance of primary cultures to pleomorphic cultures of *A. Schoenleini* at first led Sabouraud to think that they might be the same species, with the characters observed due to host reaction, as had been elaborately suggested by Busquet (1890, 1891, 1892), without experimental evidence, but this hypothesis was abandoned by Sabouraud before his classic work in 1910. Grigorakis (1925) has recently revived and extended this idea to include all the dermatophytes. Bodin (1902) after a study of the nutrition of this organism claimed that it was more closely related to the species of *Microsporum* and *Trichophyton* than to *Achorion Schoenleini.* Ota & Langeron (1923) also placed it in their genus *Sabouraudites* along with *Microsporum* and *Ectotrichophyton.*

Achorion cupressiforme Aoki, Festschr. Keizo Dohi, 517-574, *Pls. 40-42*, 1917.

Achorion sp. Aoki, Derm. Woch. **59**: 863-872, 1914.

Producing favus turriformis and favus confertus on glabrous skin with lesions also on scalp. In one case there was swelling of lymph nodes with cheesy pus formation. Easily inoculable to mouse and rabbit, producing whitish scutula and healing spontaneously.

Mycelium septate with swollen cells becoming chlamydospores, a few closterospores present; arthrospores in scutula 3-8 × 2.5-5μ.

Growth rapid in medium, slow on surface, rapid in depths suggesting cypress leaves, white becoming dirty white and finally yellowish white, surface smooth and waxy. Center elevated, surrounded by a flat waxy zone with periphery below surface of the medium. Reverse bright yellow. On broth, floating floccose white colony becoming yellowish white, chlamydospores abundant. On milk, growth slow, coagulated and digested after several weeks. On lactose agar, center elevated, irregular then crimped, brownish yellow. On potato, irregular brown to black brown, elevation surrounded by a white flat surface, growth slow. On beef broth peptone agar (slightly alkaline), colony as on Sabouraud, but moist shining and waxy, elevated in the center, surrounded by a yellow white zone, marginal portion radiating, submersed. Gelatin slowly softened (partial liquefaction), surface white then yellowish white, reverse yellow.

Achorion formoseum Hasegawa, 1927; Bruhns & Alexander, in Jadassohn, Handbuch d. Haut- u. Geschlectskrank. **11**: 233, 1928.

Lesions size of lentil, grayish white with favic scutula. Infected hair lustreless and easily epilated. Formosa. Inoculation of guinea pig easy, with typical scutula; not inoculable to mouse, ape, or hen.

Spores 3.5-4μ in the scutulum, along with septate, wavy mycelium; hair showing spores, but not the air bubbles so characteristic of *A. Schoenleini.*

In culture, mycelium septate, wavy, 3-4μ in diameter, spore chains, chlamydospores, favic candelabra and nodular organs present.

On glucose agar, bright yellow and moist, then brownish. Surface of irregular folds; in the medium radial branching fibrils.

Achorion Schoenleini (Lebert) Remak, Diagnostische und pathogenetische Untersuchungen 193, *Figs. 5, 6,* 1845.*

Oidium Schoenleini Lebert, Physiologie pathologique **2**: 490, 1845.†

Oidium sp. Müller & Retzius, Arch. Anat. Physiol. Wiss. Med. **1842**: 198-212, 1842.

Oidium porriginis, Montagne apud Berk. & Broome, Ann. Mag. Nat. Hist. II, **7**: 177, 1851.

Favuspilz β, Quincke, Arch. Exp. Path. Pharm. **22**: 62, 1886.

Oospora porriginis, Saccardo, Sylloge Fungorum **4**: 15, 1886.

Oidium Schoenleinii Zopf, Die Pilze 481, 1890.

Schoenleinium achorion Johan-Olsen [Sopp], Centralbl. Bakt. II, **3**: 276-284, 1897.

Grubyella Schoenleini Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 330, 1923.

Arthrosporia Schoenleinii Grigorakis, Ann. Sci. Nat. Bot. X, **7**: 414, 1925.

Achorion (Grubyella) Schoenleini Guiart & Grigorakis, Lyon Méd. **141**: 377, 1928.

Probably also the following names are synonyms:

Achorion kerotophagus Ercolani, Mem. Accad. Sci. Ist. Bologna III, **6**: 363-381, *1 pl.,* 1875; Archivio med. vet. **1**: 5-21, 1876.

Oospora porriginis var. *ceratophagus* Saccardo, Sylloge Fungorum **4**: 15, 1886.

Achorion atacton Unna.

Achorion dichroon Unna.

Achorion radians Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-72, 1893.

Achorion akromegalicum Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-72, 1893.

Achorion demergens Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-72, 1893.

Achorion cysticum Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-72, 1893.

Achorion moniliforme Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-72, 1893.

Achorion tarsiferon Neebe & Unna, Monatsh. Prakt. Derm. **16**: 17-31, 57-72, 1893.

Producing scutula and kerions in man, inoculable to guinea pig, rat, mouse, cat, and rabbit, but very rarely occurring spontaneously on these animals. In 1890, this species was reported common in Scotland, Italy, Spain, Austria, Poland, Volga and Caucasus governments of Russia, China, Central Asia, and Abyssinia, occasional in Holland, Scandinavia, and France, rare in England, Switzerland, America, and Japan. At present it is reported common in Southern Japan, Algeria, Holland, Rhine Valley, and Eastern Germany, especially in Schlesien, Bosnia, Hungary, Poland, and the Russian border states, Transcaucasia, Bessarabia, Italy, and Scotland. Occasional in France, rare in Formosa, Northern Japan, Manchuria, United States, Portugal, Argentina, and São Paulo in Brazil.

---

*This work appeared in the latter part of 1845 according to Hinrichs, J. C. Verzeichnisse der Bücher Landkarten u.s.w. welche von Juli bis Dezember 1845 neu erscheinen sind. 194, 1845.

†This work appeared not later than July 25, 1845, according to Bibliographie de France 399, 1845. No. 3818 for July 26, 1845.

Ordinarily only arthrospores present, but aleurospores abundant on grains of barley and carrot, much less on potato and wheat, none on other media so far reported. Aleurospores 6.5-7 × 5-5.5μ.

Cultures on Sabouraud agar yellowish white similar to fresh beeswax; colony cerebriform, heaped, not spreading. Form constant on the usual media, varying in the fineness of convolutions, size, and rapidity of development. Successive subcultures grow more rapidly, colonies never velvety until pleomorphism sets in when they become cottony, white. Before pleomorphism, best growth on high nitrogen and low carbohydrate media, while after pleomorphism, the proportions are reversed. Pleomorphic cultures of *A. Schoenleini* are suggestive of primary cultures of *A. muris.* On potato and carrot, colonies dirty white, elevated, irregular, not velvety, not producing pigment on media. On gelatin and coagulated serum small irregular colony, whitish, not velvety; liquefaction begins in about a week but is very slow. On milk, casein completely digested in 3 weeks. At 37° C. growth rapid, colony disciform. On wheat, colonies small, irregular, grayish yellow masses with wrinkled surface. After 7 months they become powdery, white.

Grigorakis (1933) has renamed a pleomorphic strain of this species *Arthrosporia Gougeroti.*

Chen, Kurotchkin and Hu (1931) described a buff variety common in Peiping, China. Colony 2.5-5 mm. in 7 days, small round, smooth surface, slightly powdery and buff. Submerged growth profuse 3-4 cm. in 10 days, composed of deep radial rays. After 2 weeks, secondary growths buff and glabrous or white with short velvet. Morphology and lesions of *A. Schoenleini.* Guinea pig inoculation resulted in about 50% infection. When scutula were used, only superficial scaly lesions developed, while inoculation from cultures produced small typical scutula.

Var. **mongolica** (Hashimoto & Ota) Dodge, n. comb.

Grubyella Schoenleini var. *mongolica* Hashimoto & Ota, Jap. Jour. Derm. Urol. **27**: 386-409 [33-35], 1927.

Producing favus in Mongolia, mouse very susceptible, with a large deep scutulum. On guinea pig and rabbit slight lesion, spontaneously healing.

On glucose, maltose, or conservation agar, mycelium straight, frequently branched, rarely undulate, septa distant. Intercalary chlamydospores, pectinate organs, favic candelabra, nodular organs(?) (resembling "cocon d'une chrysalide entre des brindelles").

Disc 4 cm., chestnut maroon with irregular radial furrows, margin fringed; daughter colonies may appear on mother colony or at its margin, elevated white chalky or yellowish brown. Subcultures on conservation agar increasingly elevated and folded, becoming yellowish gray. Subcultures on Sabouraud sugar media begin to resemble *T. flavum* or *T. plicatile,* 5-8 cm. in diameter, crumpled, center brown, cracks in gray powdery surface, margin of fine rays.

Achorion passerinum Fischer, Derm. Woch. **87**: 1359-1361, *2 figs.*, 1928.

Producing large scutula on canary, a herpetic lesion on man, not pathogenic for white mouse.

Only intercalary or, rarely, terminal chlamydospores present; closterospores and aleurospores absent.

Colony very slow growth, center with a thin white velvet, with radial folds, fracturing in the center.

Probably close to *Achorion gallinae* but white.

Achorion niveum Greco, Origine des Tumeurs 67-83, *Figs. 15-28,* 1916.

Producing small nodule like a lentil on the *"cou-de pied,"* covered with a crust, followed two months later by swelling of leg and redness. Followed by similar nodules on other parts of the body. Pathology and case history described in detail.

Filaments flexuous, 1-2μ in diameter, granulous, intercalary chlamydospores 4-6μ, round or fusiform, occasionally up to 8-10μ, sometimes terminal. Endoconidia sometimes formed.

Growth does not show for about 15 days on ordinary agars. On simple agar, small cerebriform elevations resembling *A. Schoenleini.* On Sabouraud conservation agar, potato, and carrot, elevations dull gray, with a fine pure white nap of fascicles of hyphae. Similar structures below the surface brownish gray. Colony finally crateriform, on Sabouraud agar.

Achorion caninum (Costantin & Sabrazès) Dodge, n. comb.

Oospora canina Costantin & Sabrazès, Arch. Méd. Exp. **5**: 354-358, 1893.

Bodinia canina Brumpt, Précis Parasitol. ed. 4, 1297, 1298, 1927.

Producing favus in dog, inoculable to man, mouse, and dog.

Mycelium septate without favic candelabra; chlamydospores similar to those of *A. Schoenleini,* rare; in the scutula, long chains of ovoid arthrospores 5-6μ and fascicles of hyphae staining less deeply.

Colony with short velvet, thick pure white, here and there powdery, red pigment diffusing as in *A. gallinae* but darker. On milk, colony bright red. On malt, pellicle adherent to walls of tube, wavy, snow white, reverse dark red and medium becomes deep red. On potato, brown acuminate peaks, surrounded by an extensive white velvet. Only chlamydospores and arthrospores known, the former rare. Cytology not studied and its positions somewhat uncertain. In lesions agreeing so closely that it seems to belong here.

Achorion africana Dodge, n. sp.

Achorion sp. Mitchell & Robertson, South African Med. Record 1915; Med. Jour. S. Africa **20**: 122-125, *4 figs.,* 1924.

Producing *witkop* or *dikwakwadi* in syphilitic natives in Bechuanaland; for description of lesions see p. 443. Inoculable to mice where lesion causes pruritus, minute papules, the exudate causes several hairs to adhere and after a time a grayish white powdery dust occurs about the edge of the lesion. The scratching caused by the pruritus prevents the typical white scutulum from developing. The fungus was reisolated from the experimental lesions.

Arthrospores isodiametric, cylindric, invading hair follicle, while medium is moist and colony young, suggesting colliform colonies etched with fine wavy lines. After 10-12 days fine snow white filaments, coarse and white as if dusted with dry lime. Slight growth downward into the medium, making the colony very adherent to the medium.

Mitchell & Robertson argue that it is not syphilitic in origin since arsenical and mercuric antisyphilitics have no effect, while it clears up in 2-3 weeks on treatment with dilute nitrate of mercury ointment, although 2-3 months are necessary to eradicate it completely. The incidence of the disease is from infancy to late puberty. It tends to disappear or become less after puberty. Occasionally new hair grows where the crust or scutulum is removed, but more often scar formation results in alopecia, in which case the condition is called *"kaalkop."* One boy showed no evidence of present syphilis and gave a negative Wassermann reaction. None of the 4 cases intensively studied showed any other lesions suggestive of syphilis.

Achorion annulosum Cazalbou, Rev. Path. Comp. **14**: 131-144, *2 figs.*, 1914.

Bodinia annulosa Ota & Langeron, Ann. Parasitol. Hum. Comp. **1**: 329, 1923.

Colony brown gray greenish, glabrous with concentric rings, mycelium hyaline with refringent granules, spores 3-6μ.

Grubyella angolensis Brumpt, Précis Parasitol. ed. 4, 1304, 1927; Froilano de Mello & Paes, Rev. Med. Angola, 505-513, 1923; Cong. Med. Trop. Afrique Occidentale, Loanda, 1923.

Lesions similar to *Microsporum* in many details, crusts lighter and less agglomerated than in *Trichophyton;* on horse, France. Not inoculable into guinea pig. Hair grayish. Invading mycelium 2-4μ(-5μ) in diameter, slightly branched, straight or slightly sinuous, rarely septate. Spores variable in size in spore sheath, up to 7μ, sometimes irregular. Fringe of Adamson in root of hair.

Chlamydospores up to 20μ, hyphae 3-4μ, of variable diameter. Aleurospores present.

Colony in 20 days at 25° C. is 4 cm. in diameter, little elevated above medium, surface of dark brown, smooth, concentric zones between fine, velvety, greenish gray zones of equal width, center slight velvety elevation, periphery of fine radiations, outer half of slight radial folds. The velvet gradually disappears and by the thirty-fifth day colony is glabrous, moist, finely verrucose, at first deep brown, then color of gingerbread. Immersed margin deep orange; reverse concolorous. On Sabouraud glucose, less growth, glabrous zones deep orange, velvety zones grayish, the glabrous zones giving way to short velvet of the same grayish shade. On peptone glucose broth, large, immersed yellowish gray plaques, soon filling the space occupied by the medium. Odor of urine.

BIBLIOGRAPHY

Abramowitz, E. William. 1931. Local medication in diseases of the skin. Indications, actions and uses of the various active ingredients and vehicles, *Arch. Derm. Syphilol.* 23: 644-680.

Acton, Hugh W. & C. McGuire. 1927. Tinea cruris: its manifestations, diagnosis and treatment, *Indian Med. Gaz.* 62: 419-428, *8 pls.*

Agostini, Angela. 1930. Una nuova specie di ''Bodinia'' causa di tigna umana nell'Eritrea, *Atti Ist. Bot. R. Univ. Pavia.* IV, 2: 117-125.

*Akagi, Shozô. 1926. A new dermatosis caused by a fungus, *Jap. Jour. Derm. Urol.* 26: 55.

*—. 1927. Parasitic skin disease (Unusual previously undescribed skin lesion), *Jap. Jour. Derm. Urol.* 27: 9.

Alexander, Arthur. 1912. Beiträge zur Kenntnis des Eczema marginatum, *Arch. Derm. Syphilis.* 113: 11-38, *Pl. 1.*

—. 1922. Statistik der Pilzflora. 1919-1920. (a) Trichophyton persicolor; (b) Interdigital Soormycose; (c) Lychen chronicus Vidal, *Arch. Derm. Syphilis* 138: 410-415.

—. 1922. Die Trichophytie der Hände und Füsse, *Med. Klin.* 18: 2: 1550-1553.

—. 1925. Zur Klinik seltener Soorformen. (a) Dyshidrosis sicca lamellosa oidiomycetica. (b) Paronychie mit sekundärem Soor der Nagel, *Derm. Zeitschr.* 53: 5-12.

—. 1927. Über die durch den Kaufmann-Wolfschen Pilz hervorgerufenden Hauterkrankungen der Hände und Füsse mit besonderer Berücksichtigung der Dyshidrosis sicca lamellosa, *Med. Klin.* 23: 275-278.

Alfonso, José. 1929. Estudio de los hongos en algunas enfermedades parasitarias *Bol. Soc. Cubana Derm. Sifilogr.* 1: 217-224.

Allison, J. Richard. 1927. Fungus disease of the skin, *Southern Med. Jour.* 20: 604-606.

Amberg, Samuel. 1910. The cutaneous trichophytin reaction, *Jour. Exp. Med.* 12: 435-459, *Pl. 39.*

Ambrosoli, Gian Angelo. 1921. Coltura di Trichophyton gypseum dal sangue circolante in tricofizia profonda con lichen trichophyticus, *Giorn. Ital. Mal. Ven. Pelle.* 62: 233-240, *1 pl.*

—. 1923. Favide, reazione cutanea generalizzata alla tigna favosa, *Giorn. Ital. Mal. Ven. Pelle.* 64: 147-157, *1 pl.*

—. 1925. Lichen trichophyticus in tre fratelli affetti da kerion Celsi (da Trichophyton rosaceum), *Giorn. Ital. Derm. Sifilol.* 66: 628-640, *1 pl.*

*—. 1926-1927. Coltura di Achorion Schoenleinii dal sangue circolante in un caso di tigna favosa, *Giorn. Ital. Derm. Sifilol.* 67: 1552, 1926; 68: 820, 1927. [Same title, *Policlinico, Sez. Prat.* 34: 487, 488, 1927.]

—. 1927. Epidemia di tigna da Trichophyton glabrum osservata in Italia, *Giorn. Ital. Derm. Sifilol.* 68: 1011-1020.

Americo da Veiga. 1929. Algumas especies novas de cogumelos causadores de tinhas, *Brasil Med.* 43: 830-838, *4 figs.*

Andrews, George C. 1927. Tinea capitis in an adult, *Arch. Derm. Syphilol.* 16: 477.

Aoki, T. 1910. Über die Mikrosporie besonders auf der unbehaarten Haut (in Japan Hatake genannt), *Monatsh. Prakt. Derm.* 50: 390-396.

—. 1912. Methode der Ausstrichkulturen beim Studium von Epidermispilzen, *Jap. Zeitschr. Derm. Urol.* 12: 838-872, *11 figs.* [66-68].

—. 1914. Über den Favus der unbehaarten Haut in Japan mit besonderer Berücksichtigung der bakteriologischen Untersuchung, *Derm. Woch.* 59: 863-872.

—. 1917. Untersuchungen über den Favus in Japan, *Festschrift, Keizo Dohi* 517-574, *Pls. 40-42.* [Ergänzungsband zur *Jap. Zeitschr. Derm. Urol.*]

Arijewitsch, A. 1930. Zur Frage der Pilzerkrankungen der Augenlider und Wimpern, *Derm. Woch.* 90: 683-685, *1 fig.*

Arnold, Walter. 1921. Die intradermale Trichophytinreaktion beim Kind, *Arch. Derm. Syphilis.* 136: 125-134.

Aroeira Neves. 1923. Contribuição ao estudo das dermatomycoses em Bello Horizonte. Observações sobre casos provocados pelo Microsporon felineum C. Fox e F. Blaxal 1896, *Brasil Med.* 36: 1: 144-149.

*—. 1923. Contribuição ao estudo das dermatomycoses em Bello Horizonte. Trichophycia do couro cabelludo pelo Tricophyton cerebriforme Sabouraud, 1893 (Tricophyton flavum Bodin 1902), *Arch. Mineiros. de Dermat. Syphiligr.* 5: Nos. 17-20.

—. 1923. Sobre um caso de Favus em um gallo causado pelo Achorion gallinae (Mégnin 1881), *Brasil Med.* 37: 2: 198.

Aronstam, Noah E. 1922. Epidermophyton inguinale with unusual distribution, with report of 4 cases [in one family], *Urol. Cut. Rev.* 26: 280.

Artom, Mario. 1933. Imponenti formazioni tumorali da Trichophyton in tricofizia universale, *Giorn. Ital. Derm. Sifilol.* 74: 563-582, *10 pls.*

Arzt, Leopold & Herbert Fuhs. 1921. Über mykotische Allgemeininfektionen bei Trichophytie und Mikrosporie (''Trichophytosen und Mikrosporosen''), *Arch. Derm. Syphilis* 136: 333-344.

—. 1921. Über Sycosis parasitaria mit besonderer Berücksichtigung der speziellen Therapie, *Derm. Zeitschr.* 32: 91-113.

—. 1922. Weitere Beiträge zur Klinik und Therapie der Audouinischen Mikrosporie. (Herpes tonsurans microsporicus und Mikrosporid), *Acta Dermato-venereol.* 3: 1-20, *Pl. 1.*

—. 1923. Über Allgemeinerkrankungen bei Audouinischer Mikrosporie, *Acta Dermato-venereol.* 4: 59-94, *Pl. 3.*

—. 1923. Zur Entstehung der Allgemeinexantheme bei Mikrosporie, *Arch. Derm. Syphilis* 143: 52-56, *1 fig.*

—. 1923. Über durch Trichophyton violaceum hervorgerufene Pilzerkrankungen. Ein Beitrag zur Pilzflora in Wien, *Derm. Woch.* 76: 409-414.

—. 1923. Über diagnostische Impfergebnisse mit Mikrosporin (Höchst) bei Mikrosporie und artverwandten Pilzerkrankungen, *Derm. Woch.* 77: 997-999.

—. 1924. Zur Kenntnis der durch das Epidermophyton inguinale (Sabouraud) hervorgerufenen Hauterkrankungen, *Derm. Zeitschr.* 41: 97-103.

—. 1925. Über eine seltenere Form der atypischen Audouinischen Mikrosporie: kerion Mikrosporicum, *Arch. Derm. Syphilis* 149: 9-12.

—. 1928. Die Mikrosporie, *Handbuch der Haut- und Geschlechts-krankheiten.* [Jadassohn.] 11: 607-654, *30 figs.*

Ashford, Bailey K., Earl B. McKinley & George B. Dowling. 1930. Experimental inoculation of monkeys (Silenus rhesus) and guinea pigs with two dermatophytes and one Blastomycoides. *Porto Rico Jour. Publ. Health Trop. Med.* 5: 452-457, *1 pl.*

Ayres, Samuel Jr. & Nelson Paul Anderson. 1934. Inhibition of fungi in cultures by blood serum from patients with phytid eruptions, *Arch. Derm. Syphilol.* 29: 537-547.

Balbi, Edoardo. 1933. Anticutine e procutine nelle dermatomicosi, *Giorn. Ital. Derm. Sifilol.* 74: 889-910.

*Baliña, P. E. Aubrun, & Pablo Negroni. 1930. Epidermomicosis por Epidermophyton rubrum de Castellani, *Asoc. Argentina Derm. Sif.* 4 abril.

Ballagi, Stefan. 1926. Die in Ungarn einheimischen Mikrosporon Trichophyton Epidermophyton und Achorionpilze, *Derm. Woch.* 83: 1155-1169.

Ballagi, Stefan & Stefan Laubál. 1933. Über Meerschweinchenimpfungen mit Schimmelpilzen und Dermatophytenarten, *Arch. Derm. Syphilis* 167: 394-400, *5 figs.*

Ballarini, M. 1925. Casi di tricofizie a sede insolita, *Arch. Ital. Derm. Sif. Ven.* 1: 76-80 *5 figs.*

Balzer, Félix. 1883. Notes sur l'histologie des dermatophytes, *Arch. Physiol.* III, 2: 466-474.

—. 1881. Recherches histologiques sur le favus et la trichophytie, *Arch. Gén. Méd.* 148: 385-410.

Bang, Henrik. 1910. Sur une trichophytie cutanée à grands cercles causée par un dermatophyte nouveau, Trichophyton purpureum Bang, *Ann. Derm. Syphiligr.* V, 1: 225-238.

Barbaglia, Vittorio. 1914. I Tricofiti della provincia di Sassari, *Giorn. Ital. Mal. Ven. Pelle.* 55: 911-929.

—. 1931. Su un caso di favide. Contributo all' étiologia ed alla patogenesi del favide, *Arch. Ital. Derm. Sif. Ven.* 6: 337-354, *5 figs.*

Barbalian. 1932. Épidémie de trichophytie cutanée dans une maison de couture, *Bull. Soc. Franç. Derm. Syphiligr.* [43:] 543-546.

Bargum. 1909. Kerion bei Mikrosporie, *Monatsh. Prakt. Derm.* 39: 84-87.

*Bassewitz, F. von. 1926. Frequencia das dermatomycoses no Rio Grande do Sul, *Congr. Sudamericano de Derm.* 1: 21. [*Ann. Derm. Syphiligr.* VI, 7: 365, 1926].

*Baudet, E. A. R. F. 1921. Herpes bij het paard veroorzakt dorr Trichophyton granulosum, *Tijdschr. Diergeneesk.* 48: 379-390.

—. 1930. Sur une teigne trichophytique du dromedaire produite par une espèce nouvelle de Grubyella, G. Langeroni n. sp., *Ann. Parasitol Hum. Comp.* 8: 411-418, *2 pls., 6 figs.*

—. 1930. Sur un cas de teigne humaine produite par un dermatophyte mégaspore, *Ann. Parasitol. Hum. Comp.* 8: 512-519, *1 pl., 6 figs.*

—. 1930. Particularités d'une teigne megasporée d'un veau, *Ann. Parasitol. Hum. Comp.* 8: 520-522.

—. 1931. Les Trichophyton à cultures faviformes sur milieux à base de polysaccharides d'Langeron et Milochevitch, *Ann. Parasitol. Hum. Comp.* 9: 546-551, *Pls. 12, 13.*

—. 1932. Recherches experimentales sur les Trichophyton animaux à cultures faviformes, *Ann. Parasitol. Hum. Comp.* 10: 520-541, *Pls. 24-30.*

*Bazin, [Antoine Pierre] Ernest. 1854. Considerations sur la mentagre et les teignes de la face, Paris.

*—. 1855. Recherches sur la nature et le traitement des teignes, Paris, 152 pp.

—. 1858. Leçons théoriques et cliniques sur les affections cutanées parasitaires (redigées par A. Porquet) Paris, 236 pp., *5 pls.* ed. 2, Paris; 292 pp., *5 pls.*, 1862.

Beckett, Clinton G. 1930. Ringworm or tinea infection of the toes, *U. S. Veterans Hospital Bull.* 6: 793-798.

Beclerc. 1894. Les teignes tondantes à l'école des teigneux de l'hôpital Saint-Louis (École Lailler), *Ann. Derm. Syphiligr.* III, 5: 685-693.

Beeson, B. Barker. 1915. Ringworm of the scalp in Chicago, a bacteriological study of one hundred cases, *Jour. Cut. Dis.* 33: 731-737, *Pls. 42, 43.*

Behdjet, Houloussi. 1927. Die Trichophytie der Augenbrauen und der Wimpern und die seltenen Formen der Trichophytie, *Derm. Woch.* 85: 1028, 1029.

—. 1930. Epidermophytie Castellani oder Trichophyton purpureum Bang, *Derm. Woch.* 91: 1623, 1624.

Beigel, Hermann. 1865. Über Auftreten und Bersten der Haare, eine eigenthümliche Erkrankung des Haarschaftes, *Sitzungsber. Math. Naturw. Kl. K. Akad. Wiss. Wien.* 17: 612-617, *1 pl.*

Beintema, K. 1933. Klinische und kulturelle Beobachtungen bei Achorion Quinckeanum, *Derm. Zeitschr.* 68: 21-27, *3 figs.*

—. 1934. Über einem neuen Pilz der Endothrixgruppe: Trichophyton floriforme n. sp., *Arch. Derm. Syphilis* 169: 577-581.

Bellini, A. 1899. Studio sulla profilassi e la cura delle tigne, *Giorn. Ital. Mal. Ven. Pelle.* 40: 70-104.

Bennett, John Hughes. 1842. On the vegetable nature of tinea favosa (Porrigo lupinosa of Bateman) its symptoms, causes, pathology and treatment, *London & Edinburgh Monthly Journ. Med. Sci.* 2: 504-519, *Pl. 5.*

Berde, Károly von. 1926. über die Widerstandsfähigkeit des Mikrosporon Audouini, *Arch. Derm. Syphilis* **150**: 225-235.

—. 1926. über die pathogene Fadenpilzflora in Südungarn, *Arch. Derm. Syphilis* **152**: 126-131.

—. 1927. Delmagyarország Kórokozó fonálgombaflórajól, *Folia Cryptogamica* [Szeged] **1**: col. 279-282. [Tr. über die pathogene Fadenpilzflora in Südungarn. col. 283-286.]

—. 1927. Favus capitis unter dem Bilde einer Folliculitis sclerotisans, *Derm. Woch.* **84**: 669-676, *5 figs.* [**Börgyogyaszati Urol. is Venerol. Szemle.* 4: 269, 1926, in Hungarian.]

—. 1930. Die regionären Eigenheiten und die epidemiologischen Verhältnisse der Dermatophytonflora in Ungarn, *Arch. Derm. Syphilis* **162**: 777-781.

Berde, Károly von & S. von Szentkirályi. 1928. Ein Beitrag zur Forschung über die Dermatophytenflora der ungarischen Tiefebene, *Arch. Derm. Syphilis* **154**: 490-492.

Berger, F. R. M. 1907. Die Behandlung der Mikrosporie, Trichophytie und des Favus mit Röntgenstrahlen, *Arch. Derm. Syphilis* **88**: 179-221, *Pl. 7.*

*Bernuzzi, F. 1923. Ricerche sulla trichophyzie nelle provincia di Cagliari, *Giorn. Ital. Mal. Ven. Pelle.* **64**: 698.

Bessunger, August. 1915. Untersuchungen über Dermatomykosen an der Bonner Hautklinik, *Inaug. Diss. Bonn.* 31 pp.

—. 1917. Über epidemisches auftreten von Trichophyton rosaceum, *Derm. Woch.* **65**: 859, 860.

Bhatnagar, Shanti Swarupa & Krishna Kuma Mathur. 1924. Physikalisch-chemisch Vorgänge beim Wachsen von Herpes tonsurans, *Kolloid-Zeitschr.* **34**: 104-108.

Biltris, R. 1929. Sur la variabilité des caractères de l'espèce chez les dermatophytes, *Ann. Inst. Pasteur* **43**: 281-358, *15 figs.*

Blanchard, Raphael. 1896. Parasites végétaux à l'exclusion des bactèries, *Traité de pathologie générale* [Charles Bouchard]. **2**: 811-926.

Bloch, Bruno. 1908. Die Trichophytien, *Med. Klin.* **4**: 1942-1948.

—. 1908. Zur Lehre von den Dermatomykosen (Klinisch-epidemiologische und experimentell-biologische Beiträge), *Arch. Derm. Syphilis* **93**: 157-220, *Pls. 8-12.*

—. 1911. über das Vorkommen des Mäusefavus beim Menschen und seine Stellung im System der Dermatomykosen, *Derm. Zeitschr.* **18**: 451-461.

—. 1911. Das Achorion violaceum, ein bisher unbekannter Favuspilz, *Derm. Zeitschr.* **18**: 815-822, *Pls. 10-12.*

—. 1912. Die Trichophytien und verwandten Pilzerkrankungen der Haut, *Korresp.-Bl. Schweiz. Ärzte.* **42**: 2-16.

—. 1915. Ueber einige allgemein pathologische und therapeutische Probleme auf dem Gebiete der Dermatomykosen, *München. Med. Woch.* **6**: 737-740, 773-776.

—. 1921. Les trichophytides, *Ann. Derm. Syphiligr.* VI, **2**: 1-16; 55-71.

—. 1921. Zur Pathogenese der Trichophytide, *Arch. Derm. Syphilis* **129**: 134-154.

—. 1928. Allgemeine und experimentelle Biologie der durch Hyphomyceten erzeugten Dermatomykosen, *Handbuch der Haut- und Geschlechtskrankheiten* [Jadassohn]. **11**: 300-377, *12 figs.*

—. 1928. Die Trichophytide, *Handbuch der Haut- und Geschlechtskrankheiten.* [Jadassohn]. **11**: 565-606, *7 figs.*

—. 1929. über das Problem der Organotropie. Ursachen der speziellen Lokalisation der Dermatomykosen auf der Haut (Dermatotropie und Merotropie), *Schweiz. Med. Woch.* **10**: 60-63.

—. 1932. Eine unter dem Bilde einer Erythrodermie verlaufende fast universelle durch Trichophyton gypseum verursachte Dermatomykose, *Arch. Derm. Syphilis* **165**: 149-156, *2 figs.*

Bloch, Bruno, A. Labouchère & Fr. Schaaf. 1925. Versuche einer chemische Charakterisierung und Reindarstellung des Trichophytins (des aktiven, antigenen Prinzips pathogener Hautpilze), *Arch. Derm. Syphilis* 148: 413-424.

Bloch, Bruno & R. Massini. 1909. Studien über Immunität und Überempfindlichkeit bei Hyphomyceten-erkrankungen, *Zeitschr. Hyg.* 63: 68-90, *1 fig.*

Blumenfeld, A. 1931. Kerion microsporicum with hematogenous and ectogenous microsporids. Report of a case with reference to the literature, *Arch. Derm. Syphilol.* 24: 607-613, *6 figs.*

Blumenthal, Franz & Asta von [Mallinckrodt] Haupt. 1920. Immunisatorische Vorgänge bei der Trichophytie des Menschen, *Deutsch. Med. Woch.* 46: 37-39.

—. 1922. Über das Vorkommen von Antikörper im Blutserum trichophytiekranker Menschen. *Derm. Zeitschr.* 36: 313-336.

—. 1923. Zur biologie der Hautpilze. *I, Arch. Derm. Syphilis* 144: 458-475.

Bodin, Eugène. 1896. Sur les favus à lésions trichophytoides, *C. R. Soc. Biol.* 48: 711-713.

—. 1896. Les teignes tondantes du cheval et leur inoculations humaines, Thèse. Paris. 128 pp., *16 figs.*

—. 1897. Note mycologique sur le Microsporum trouvé à Parme par M. Mibelli, *Ann. Derm. Syphiligr.* III, 8: 1145-1148.

—. 1898. Sur les champignons intermediaires aux Trichophytons et Achorions, *C. R. Acad. Sci.* 126: 1528, 1529.

—. 1899. Le Microsporum du cheval, *Arch. de Parasitol.* 1: 379-409, *5 figs.*

—. 1899. Note additionnelle sur le forme Oospora du Microsporum du cheval, *Arch. de Parasitol.* 2: 606-609.

—. 1902. Sur le champignon du favus de la souris (Achorion Quinckeanum), *Arch. de Parasitol.* 5: 5-30.

—. 1907. Sur un nouveau champignon du favus (Achorion gypseum), *Ann. Derm. Syphiligr.* IV, 8: 585-602, *1 pl.*

—. 1910. Coëxistence des teignes faveuse et trichophytique sur un même cuir chevelu, *Ann. Derm. Syphiligr.* V, 1: 327-329.

—. 1925. Deux cas de trichophytie dus à un Trichophyton faviforme, *Bull. Soc. Franç. Derm. Syphiligr.* 32: 435-439.

Bodin, Eugène & J. Almy. 1897. Le microsporum du chien, *Recueil Méd. Vét.* VIII, 4: 161-183, *Pl. 1.*

Boenke, Rudolf. 1925. Parasitic eczema, *Med. Jour. & Rec.* 122: 91-93.

Bogrov, S. L. & N. A. Chernogubov. 1913. Trichophytie der Erwachsenen, *Derm. Woch.* 57: 1027-1032.

Bolam, Robert A. 1912. Trichophyton rosaceum, *Brit. Jour. Derm. Syphilis* 24: 1-13, *1 pl., 7 figs.*

Bonar, Lee & Alice Domsler Dreyer. 1932. Studies on ringworm funguses with references to public health problems, *Amer. Jour. Public Health* 22: 909-926 [archaic spelling ''funguses'' forced on authors by editor].

Bonnafy. 1893. La tokelau, *Arch. Med. Nav. Colon.* 60: 241-261.

Borkowski, Vitold & Franc Krzysztalowicz. 1925. La trichophytie du cuir chevelu des adultes, *Ann. Derm. Syphiligr.* VI, 6: 597-601.

Bouchard, Charles. 1860. Études expérimentales sur l'identité de l'herpès circiné et de l'herpès tonsurant, Lyon, 16 pp.

Brandt, Thore. 1932. Report on an epidemic of trichophytosis, *Acta Derm. Venereol.* 13: 443-448.

Braude, R. & M. Per. 1927. Beitrag zur Klinik and Ätiologie der verbreiteten Trichophytide bzw. Mikrosporide. Exantheme, Lichen trichophyticus (Jadassohn-Bloch) und Lichen mikrosporicus (Arzt und Fuhs.), *Zeitschr. Kinderheilk.* 43: 525-536.

Brault, J. 1916. Note sur le Trichophyton luxurians nouvelle expéce, à culture faviforme produisant des kerions, *Ann. Derm. Syphiligr.* V, 6: 91-94, *2 figs.*

Brault, J. & A. Viguier. 1914. Note sur une nouvelle espèce de Trichophyton à culture faviforme isolée à Alger, *C. R. Soc. Biol.* 77: 342, 343.

—. 1914. Les champignons des teignes à Alger, *Bull. Soc. Path. Exot.* 7: 554-556.

—. 1914. Deux cas de kerion Celsi observés à Alger et dus à une nouvelle espèce de Trichophyton à cultures faviformes, *Bull. Soc. Franç. Derm. Syphiligr.* 25: 401, 402.

—. 1916. Les champignons des teignes rencontrées à Alger, *Ann. Derm. Syphiligr.* V, 6: 169-185.

Bresciani, Giovanni. 1925. Contributo casistico allo studio delle onicomicosi. Rare onicomicosi da Microsporum Audouini, *Giorn. Ital. Derm. Sifilol.* 66: 1085-1109, *2 pls.*

*Brochet, L. & Wilhelm. 1932. Mycose cutanée observée à Téheran, *Fol. Med. Internat. Orient.* 1: 104, 105.

Brocq-Rousseau, D. 1926. Étude épidémiologique des teignes du cheval, *Bull. Acad. Méd. Paris.* III, 95: 242, 243.

Brocq-Rousseau, D., Achille Urbain & J. Barotte. 1926. Anticorps dans les teignes expérimentales, *C. R. Soc. Biol.* 95: 464-466.

—. 1926. Sur l'électivité cutanée des teignes animales quelle que soit leur voie d'introduction dans l'organisme, *C. R. Soc. Biol.* 95: 966, 967.

—. 1927. Étude des teignes du cheval et de l'immunité dans les teignes expérimentales, *Ann. Inst. Pasteur* 41: 513-551.

—. 1928. Cultures de Trichophyton gypseum en dehors de l'organisme et des milieux usuels, *C. R. Soc. Biol.* 99: 367, 368.

—. 1928. Cultures de Trichophyton gypseum en dehors de l'organisme et des milieux usuels. Vitalité et virulence. Remarques épidémiologiques, *Ann. Inst. Pasteur* 42: 895-906, *2 figs.*

Brünauer, Stefan Robert. 1922. Epidermophytia inguinalis generalisata mit Beteiligung der Nägel, *Derm. Zeitschr.* 35: 148-153.

Bruhns, Carl. 1910. Neuere Anschauungen und Erfahrungen über die Trichophytie-erkrankungen, *Berlin. Klin. Wochenschr.* 47: 832-836.

—. 1918. Zur gegenwärtigen Bartflechtenepidemie, *Derm. Woch.* 66: 225-229.

—. 1930. Über die Frage der Askenbildung bei Trichophyton und Achorion bei dem Verfahren nach Wilenczyk und über Organes nodulaires, *Derm. Woch.* 90: 49-53.

Bruhns, Carl & Arthur Alexander. 1910. Zur Frage der Immunität nach Trichophytie-erkrankungen, *Derm. Zeitschr.* 17: 695-706.

—. 1928. Allgemeine Mykologie, *Handbuch der Haut- und Geschlechtskrankheiten* [Jadassohn]. 11: 1-299, *160 figs.*

—. 1930. Mykologische Beiträge. I. Einteilung der Pilzarten nach rein botanischen Gesichtspunkten oder nach Sabourauds System, *Derm. Woch.* 91: 1179-1183. II. Atypische Form des Kaufmann-Wolfschen Pilzes (Epidermophyton inguinale). III. Ein Fall von Epidermophyton lanoroseum. IV. Einige Bemerkungen über den Ursprung und die Abstämmung unserer Dermatophyten, *Ibid.* 91: 1250-1253, *2 figs.*

Bruhns, Carl & Prytek. 1912. Zur Frage der Immunisierung nach Trichophytie-infektion, *Arch. Derm. Syphilis* 112: 664, 665.

Bruusgaard, E. 1922. Haematogenous infection in Trichophytia, *Acta Derm. Venereol.* 3: 21-31, *8 figs.*

—. 1922. Haematogenous infection in Trichophytia, *Brit. Jour. Derm. Syphilis* 34: 150-161, *3 pls.*

*—. 1922. Über hamatogene Trichophytie, *Norsk. Magaz. f. Laegevidenskaben.* 83: 83 [Norwegian]. *Arch. Derm. Syphilis* 138: 381-384, *4 figs.*

Bukovský, Jaroslav. 1900. Ein Beitrag zur Kenntnis der experimentellen und klinischen Eigenschaften des Achorion Schöleinii, *Arch. Derm. Syphilis* 51: 365-388, *Pl. 17.*

Burgess, J. F. 1925. Fungus infections of the skin. Report on cultural study of the flora of ringworm, *Arch. Derm. Syphilol.* 12: 853-857.

Burnier, René & Duché. 1933. Un cas d'épidermomycose due à Trichophyton rubidum, *Bull. Soo. Franç. Derm. Syphiligr.* 40: 579, 580.

Buschke, A. & Gertrud Klemm. 1921. Klinische Beobachtungen über die jetzt in Berlin herrschende Mikrosporiecpidemie, *Derm. Woch.* 72: 453-459.

Buschke, A. & Max Michael. 1921. Die Fadenpilzerkrankungen der Haut bezüglich ihre Biologie und Ausbreitung, *Ergebn. Allg. Path. Path. Anat.* 19: 800-847.

*Busquet, G. P. 1890. Étude morphologique d'un cryptogame nouveau trouvé dans une éruption circinée de la main. Thèse, Lyon.

—. 1891. Étude morphologique d'une forme d'Achorion, l'Arloini champignon du favus de la souris, *Ann. Micr.* 3: 9-21, 62-75, 136-149, *Pls. 2-4.*

—. 1892. De l'origine muridienne du favus, *Ann. Derm. Syphiligr.* III, 3: 916-923.

Bussalai, Luigi. 1921. Sopra un caso di favo scutulare delle parti glabre da Achorion Quinckeanum, *Pathologica.* 13: 473, 474.

Butler, C. S., J. E. Houghton & G. F. Cooper. 1924. Mycosis of the hands and feet, *Internat. Conf. Health Prob. Trop. Amer. U. Fruit Co.*, 500-523.

Butte, L. 1893. Les teignes (Favus, tondante, pelade). Paris . . . ix + 123 pp.

Calderone, C. 1899. Resistenza dell'Achorion Schoenleinii ai communi agenti medicamentosi, *Giorn. Ital. Mal. Ven. Pelle* 40: 49-69.

—. 1899. Antisepsi meccanica e antisepsi chimica nella cura della tigne tonsurante, *Giorn. Ital. Mal. Ven. Pelle* 40: 306-322.

Carol, W. L. L. 1926. Een geval van kerion en lichen, veroorzaakt door het Tr. faviforme album, *Nederl. Tijdschr. Geneesk.* 70: 2: 600, 601.

—. 1926. Kulturen van een vermoedelijk nieuwe soort Microsporon, *Nederl. Tijdschr. Geneesk.* 70: 2: 601.

—. 1928. A case of infection with Trichophyton faviforme album and a case of infection with Microsporum orientale (new species), *Urol. & Cut. Rev.* 32: 19-23, *9 figs.*

Carrión, A. L. 1923. Observations on dermatomycosis in Porto Rico, *Arch. Derm. Syphilol.* 7: 773-777.

—. 1929. Preliminary report on the fungus causing epidermophytosis of the general surface of the skin in Porto Rico, *Porto Rico Jour. Publ. Health & Trop. Med.* 5: 40-44, *2 figs.*

—. 1930. Observations on dermatomycosis in Porto Rico. Report on the fungus commonly associated with foot dysidrosis, *Porto Rico Jour. Publ. Health & Trop. Med.* 5: 278-282.

Carruccio, M. 1920. Myasis in favus sine favis, *Giorn. Ital. Mal. Ven. Pelle* 61: 403-407.

Caruso, S. 1926. La microsporia in Sicilia, *Giorn. Ital. Derm. Sifilol.* 67: 278-280.

Castellani, Aldo. 1905. Observations on Dhobie itch and other tropical trichophytic diseases, *British Med. Jour.* 2: 1277-1279, *4 figs.*

—. 1908. Tinea intersecta, *Trans. Internat. Derm. Cong.* 6: 665-667.

—. 1908. Note on tinea imbricata and its treatment, *Trans. Internat. Derm. Congr.* 6: 667-671, *Pls. 49, 50.*

—. 1908. Untersuchungen über tropische Trichophytosis, *Arch. Derm. Syphilis* 93: 23-42, *Pl. 2, 2 figs.*

—. 1908. Tropical dermatomycoses, *Jour. Trop. Med. Hyg.* 11: 261-268, *2 pls.*

—. 1910. Tropical bronchomycosis. Observations on a new species of Epidermophyton found in tinea cruris. A new intestinal Spirillum, *Philippine Jour. Sci.* B, 5: 197-210, *2 pls.*

—. 1910. Observations on a new species of Epidermophyton found in tinea cruris, *Brit. Jour. Derm. Syphilis* 22: 147-150, *1 pl.*

—. 1910. The growth of the fungus of tinea imbricata, Endodermophyton concentricum, on artificial media, *Jour. Trop. Med. Hyg.* 13: 370-372.

—. 1911. Further researches on the hyphomycete of tinea imbricata, *Jour. Trop. Med. Hyg.* 14: 81-83.

—. 1911. Remarks on some cultural characters of the fungi of tinea imbricata, *Jour. Trop. Med. Hyg.* 14: 146.

—. 1912. Note on the etiology of some tropical dermatomycoses (tinea cruris, tinea flava et nigra, tinea imbricata). *Proc. Roy. Soc. Med.* **6**: Derm: 31-39, *3 figs.*, also *Brit. Jour. Derm. Syphilis* **25**: 23-31, 1913.

—. 1913. Tinea imbricata (Tokelau), *Brit. Jour. Derm. Syphilis* **25**: 397-401.

—. 1919. Brief note on the cultural characters of Trichophyton balcaneum Cast., the cause of pseudo-pityriasis capitis, *Jour. Trop. Med. Hyg.* **22**: 173, 174, *2 figs.*

—. 1923. L'étiologie du tokelau, *Bull. Soc. Path. Exot.* **16**: 111-118.

—. 1924. Notes on pruritus ani of mycotic origin, *Jour. Trop. Med. Hyg.* **27**: 304-315.

—. 1925. Further observations on pruritus ani and pruritus vulvae of mycotic origin, *Jour. Trop. Med. Hyg.* **28**: 329-332.

—. 1925. Pruritus ani and pruritus vulvae of mycotic origin, *United Fruit Co. Med. Dept. Ann. Rept.* **14**: 249-256 [1926]. Also *Practitioner* **117**: 341-355, 1926.

—. 1927. Pruritus ani and pruritus vulvae of fungal origin, *New Orleans Med. Surg. Jour.* **79**: 625-633.

—. 1927. Note on the occurrence of various tineae in New Orleans, with remarks on Trichophyton Louisianicum, *New Orleans Med. Surg. Jour.* **79**: 896-899, *3 figs.*

—. 1928. Carbolfuchsin paints in the treatment of certain cases of epidermophytosis, *Ann. Med.* **23**: 351, 352.

—. 1929. Further observations on the treatment of epidermophytosis of toes (mango toe) and certain other forms of epidermophytosis by a fuchsin paint, *Jour. Trop. Med. Hyg.* **32**: 77, 78.

Catanei, A. 1928. Étude des teignes dans le Sud Oranais (Algérie), *Bull. Soc. Path. Exot.* **21**: 729-735.

—. 1928. Trichophytie expérimentale à Trichophyton violaceum du singe d'Algérie, *C. R. Soc. Biol.* **99**: 292-294.

—. 1928. À propos de la culture des champignons des teignes en dehors des milieux usuels, *C. R. Soc. Biol.* **99**: 736, 737.

—. 1929. Cultures d'Achorion Schoenleini et de Trichophyton sur milieux artificiels en présence de microbes et de produits microbiens ou sanguins, *Arch. Inst. Pasteur Algérie* **7**: 184-201, *3 pls.*

—. 1929. Les teignes du cuir chevelu chez les indigènes des environs d'Alger, *Bull. Soc. Path. Exot.* **22**: 60-64.

—. 1929. Observations statistiques et parasitologiques sur les teignes chez les indigènes du Sud Constantinois (Algérie), *Bull, Soc. Path. Exot.* **22**: 299-302.

—. 1929. Sur le pouvoir pathogène des Trichophyton violaceum et glabrum pour les animaux, *C. R. Soc. Biol.* **100**: 1108-1110.

—. 1929. Études des modifications des caractères culturaux d'un Trichophyton gypseum, *Arch. Inst. Pasteur Algérie* **7**: 287-302, *2 pls.*

—. 1930. Étude des teignes dans la Grande Kabylie, *Bull. Soc. Path. Exot.* **23**: 170-173.

—. 1930. Étude des teignes dans les agglomerations européennes d'Algérie, *Bull. Soc. Path. Exot.* **23**: 363-368.

—. 1930. Sur le parasitisme des poils dans l'infection expérimentale provoquée par des cultures pléomorphiques d'un Trichophyton gypseum, *C. R. Soc. Biol.* **105**: 348, 349.

—. 1930. Sur la production d'appareils sporifères par un champignon du groupe des Trichophyton à cultures faviformes, *C. R. Soc. Biol.* **105**: 503, 504.

—. 1931. Altération pléomorphique d'une culture de Trichophyton acuminatum, *C. R. Soc. Biol.* **106**: 343, 344.

—. 1931. Étude d'une teigne de mouton produite par une espèce nouvelle de Trichophyton, T. pruinosum n. sp., *Bull. Soc. Path. Exot.* **24**: 296-301, *1 pl.*

—. 1931. Les teignes expérimentales du singe, *Arch. Inst. Pasteur Algérie.* **9**: 1-12, *1 pl.*

—. 1931. Observations sur les caractères de souches algériennes de champignons des teignes dans diverses conditions de culture et sur leurs altérations séniles ou pléomorphiques, *Arch. Inst. Pasteur Algérie* **9**: 451-469, *Pl. 29.*

—. 1931. Recherches sur les teignes dans la région d'Oran (Algérie). Deuxième observation algérienne de microsporie due à M. Audouini, *Bull. Soc. Path. Exot.* 24: 177-181.

—. 1931. Remarques sur la valeur de la distinction spécifique des Trichophyton violaceum et glabrum, *C. R. Soc. Biol.* 106: 80, 81.

—. 1932. Resultats d'inoculations de cultures de Trichophyton radiolatum dans l'organisme de cobayes dont on scarifie la peau, *C. R. Soc. Biol.* 109: 886, 887.

—. 1932. Sur la pathogénie des trichophyties cutanées observées chez le cobaye après ingestion de cultures de Trichophyton, *C. R. Soc. Biol.* 109: 887, 888.

—. 1932. Résultats de l'étude expérimentale de Trichophyton Langeroni S. Milochevitch 1931, *C. R. Soc. Biol.* 109: 1160, 1161.

—. 1932. Recherches sur les Trichophyties cutanées obtenues chez le cobaye après introduction dans l'organisme de cultures de Trichophyton, *Arch. Inst. Pasteur Algérie* 10: 195-203.

—. 1932. Recherches sur les teignes dans quelques agglomerations de la côte orientale de l'Algérie, *Bull. Soc. Path. Exot.* 25: 101-106.

—. 1932. Résultats de l'étude des teignes dans quelques agglomerations de la côte occidentale de l'Algérie et d'une nouvelle enquête en Ouranie, *Bull. Soc. Path. Exot.* 25: 694-699.

—. 1933. Description de Trichophyton Gourvili n. sp., agent d'une teigne de l'homme, *Bull. Soc. Path. Exot.* 26: 377-381, *Pl. 1.*

—. 1933. Études sur les teignes, *Arch. Inst. Pasteur Algérie* 11: 267-399, *Pls. 33-45.*

Cattaneo, Luigi. 1923. Sulla cura della sicosi tricofitica con soluzioni iodiche per via endovenosa, *Giorn. Ital. Mal. Ven. Pelle.* 64: 435-441, *1 pl.*

*Cazalbou, L. 1910. Une épizoötie de teignes sur le cheval à Rennes en 1910, *Rev. Gén. Méd. Vét.*

—. 1913. Contribution à l'étude des Trichophyton à culture faviforme, *Rev. Gén. Méd. Vét.* 21: 432-443.

—. 1913. Note sur un nouveau favus du cheval observé à Madagascar, *Bull. Soc. Path. Exot.* 6: 300-303, *Pl. 5.*

—. 1914. Sur l'évolution culturale des dermatophytes, *Ann. Inst. Pasteur* 28: 69-87, *5 figs.*

—. 1914. Sur l'Achorion annulosum, *Rev. Path. Comp.* 14: 131-144, *2 figs.*

—. 1914. Sur l'immunité dans les trichophytices . . . , *Rev. Path. Comp.* 14: 157-160.

—. 1914. Contribution à l'étude des Trichophytons à culture faviforme, *Rev. Gén. Méd. Vét.* 24: 1-11.

—. 1914. Considérations générales sur les teignes et les cultures de leurs agents parasitaires, *Rev. Gén. Méd. Vét.* 24: 82-101.

—. 1914. Sur les teignes microsporiques des equidés. Deux Microsporons nouveaux, *Premier Congr. Internat. Path. Comp. 1912,* 2: 306-308.

—. 1914. Au sujet de la conservation des cultures de teignes, *Premier Congr. Internat. Path. Comp. 1912,* 2: 309-311.

—. 1914. Sur le Trichophyton erioton n. sp., *Bull. Soc. Centr. Méd. Vét.* 91: 118-120.

*Cazalbou, L. & Sérisé. 1913. Étude tineologique, *Rev. Vét. Militaire.*

Ceresole, G. 1906. Sur une trichophytie du daim transmissible à l'homme, *Ann. Derm. Syphiligr.* IV, 7: 743-750.

Cerutti, P. 1934. Concentrazione idrogenionica de Sudore e della superficia cutanea, *Giorn. Ital. Derm. Sifilol.* 75: 169-173.

Chable, Robert E. 1917. Über Kerion Celsi und lichenoides Exanthem bei Audouinischer Mikrosporie, *Derm. Zeitschr.* 24: 20-31.

Chajes, Benno. 1908. Mikrosporie in Berlin, *Med. Klin.* 4: 904-907.

—. 1908. Über Mikrosporieerkrankung der behaarten Kopfhaut, *Berlin. Klin. Woch.* 45: 1491-1493, *2 figs.*

—. 1910. Über das Vorkommen von Mäusefavus beim Menschen, *Med. Klin.* 6: 1: 142, 143, *1 fig.*

—. 1918. Die Pilzerkrankungen der menschlichen Haut, *Med. Klin.* 14: 312-316.

Chalmers, Albert J. & Norman Macdonald. 1915. Animal inoculations of Trichophyton discoides Sabouraud, 1909, *Jour. Trop. Med. Hyg.* 18: 121, 122, *1 pl.*

—. 1915. Trichophyton violaceum var. Khartoumense, *Jour. Trop. Med. Hyg.* 18: 145-147, *1 pl.*

Chalmers, Albert J. & Alexander Marshall. 1914. Tinea capitis tropicalis in the Anglo-Egyptian Sudan: the systematic position of the genus Trichophyton Malmsten 1845, *Jour. Trop. Med. Hyg.* 17: 257-265, 289-291, *3 pls.*

—. 1915. Tinea capitis tropicalis in an Egyptian soldier caused by Trichophyton discoides Sabouraud 1909, *Jour. Trop. Med. Hyg.* 18: 49-55, *Pls. 1-3.*

—. 1918. Notes on minor cutaneous affections seen in the Anglo-Egyptian Sudan, *Jour. Trop. Med. Hyg.* 21: 197-200, *1 pl.*

—. 1919. Trichophyton Currii, *Jour. Trop. Med. Hyg.* 22: 83, 84, *1 fig.*

Charles, Vera K. & Aline Fenner Kempton. 1934. Microsporum of cats causing ringworm in man, *Jour. Washington Acad. Sci.* 24: 222-227.

Chen, F. K. & T. J. Kurotchkin. 1931. Tinea of scalp among adults in Peiping, *Nat. Med. Jour. China* 17: 185-189, *2 pls.*

Chen, F. K., T. J. Kurotchkin & C. K. Hu. 1931. Tinea favosa in Peiping, *Nat. Med. Jour. China* 17: 529-533, *4 pls., 1 fig.*

Chieffi, Alessandro. 1916. La tigne nella provincia di Napoli, *Giorn. Ital. Mal. Ven. Pelle* 57: 140-169.

Ciarrocchi, G. 1909. I primi 250 casi di tigna, tricofitica e favosa, curati coi raggi Roentgen nell 'Ospedale di S. Gallicano, *Giorn. Ital. Mal. Ven. Pelle* 50: 56-63.

—. 1920. Sulla profilassi sociale delle tigne, *Giorn. Ital. Mal. Ven. Pelle* 61: 385-390.

Ciarrocchi, Luigi. 1933. Onicomicosi e epidermomicosi da Epidermophyton rubrum (Castellani), *Giorn. Ital. Derm. Sifilol.* 74: 1535-1549, *3 pls.*

Cifferi, Raffaele. 1928. Lo stato attuale della sistematica dei Dermatomiceti-saggio di coordinazion, *Ann. Med. Nav. Colon.* 2: 1-19.

Citron, Julius. 1905. Über das Verhalten der Favus- und Trichophytiepilze im Organismus, *Zeitschr. Hyg.* 49: 120-134.

Cleveland, D. E. H. 1927. Ringworm of the hands and feet, *Canadian Med. Ass. Jour.* 17: 68-72.

—. 1928. A case of linear sclerosis attributed to infection with Epidermophyton, *Brit. Jour. Derm. Syphilis* 40: 451-453.

—. 1928. ''Wood light'' in dermatologic diagnosis with special reference to ringworm, *Arch. Derm. Syphilol.* 18: 368-371.

Connor, J. I. 1932. Favus in mice and men, *Med. Jour. Australia* 19: 2: 765-767, *4 figs.*

Constantin, E. & M. Boyreau. 1906. Über eine psoriatische Variatät des Favus der glatten Haut, *Monatsh. Prakt. Derm.* 43: 544-548.

Cornbleet, Theodore. 1926. Cultures from the skin of apparently normal feet, *Arch. Derm. Syphilol.* 13: 670, 671.

Cortella, Emilio. 1933. Su di una forma clinica non commune delle parti glabre da Tricophyton granulosum, *Boll. Sez. Region. Soc. Ital. Derm. Sifilogr.* 1: 16-18.

Costa, S. & A. Fayet. 1914. Sur l'immunité dans les trichophyties, recherches expérimentales, *Rev. Path. Comp.* 14: 21-32.

Costantin, Julien & Jean Sabrazès. 1893. Étude morphologique des champignons du favus, *Arch. Méd. Exp.* 5: 354-358.

Cottini, G. B. 1934. Richerche su modificazioni inducibile nel pH del sudore, *Giorn. Ital. Derm. Sifilol.* 75: 173-177.

Courmont, Paul de Lyon. 1896. Inoculation à l'animal du Microsporum Audouini, *C. R. Soc. Biol.* 48: 601, 602.

—. 1896. Étude clinique et expérimentale sur quelques types nouveaux de teignes exotiques, *Arch. Méd. Exp. Anat. Path.* **8**: 700-722, *Pl. 6.*

Craik, Robert. 1921. An unusually virulent variety of Microsporon, *Brit. Med. Jour.* **1**: 672, 673.

Cremer, G. 1933. Untersuchungen über die Epidermophytie der Füsse und Hände in Amsterdam, *Arch. Derm. Syphilis* **169**: 244-258, *6 figs.*

Csillag, J. 1921. Fez und favus bei den bosnischen Mohammedanern, *Arch. Derm. Syphilis* **134**: 309-313, *12 figs.* [also **Gyógyászat. ??*; 30, 1921].

Danel, L. 1924. Sycosis trichophytique de la moustache, *Bull. Soc. Franç. Derm. Syphiligr.* **31**: 281, 282.

—. 1932. Microsporie de la peau glabre à éléments discoïdes (Microsporum felineum), *Bull. Soc. Franç. Derm. Syphiligr.* [**43**]: 547-549.

Darier, J. 1919. Dysidrosis, its parasitic nature, *Lancet* **2**: 578-580.

Darier, J. & J. Hallé. 1910. Sur un cas de granulome favique, *Ann. Derm. Syphiligr.* V, **1**: 129-136, *3 figs.*

*Datta, S. 1932. A new fungus, Eidamella Actoni, parasitic to the dog, *Indian Vet. Jour.* **8**: [1-10], *2 pls.*

Davidson, A. M. & Eleanor Silver Dowding. 1932. Tinea barbae of the upper lip, *Arch. Derm. Syphilol.* **26**: 660-662. *1 fig.*

Davidson, A. M., Eleanor Silver Dowding & Arthur Henry Reginald Buller. 1932. Hyphal fusions in dermatophytes, *Canadian Jour. Res.* **6**: 1-20, *Pls. 1-3.*

Davidson, A. M. & P. H. Gregory. 1932. A case of kerion Celsi associated with ringworm of the eyelashes and accompanied by trichophytid, *Canadian Med. Ass. Jour.* **27**: 485-487, *3 figs.*

—. 1933. Development of fuseaux, aleuriospores and spirals on detached hairs, infected by ringworm fungi, *Nature* **131**: 836, 837, *1 fig.*

—. 1933. Kitten carriers of Microsporum felineum and their detection by the fluorescence test, *Canadian Med. Ass. Jour.* **29**: 242-247.

Delbanco, Ernst. 1924. Zum Übertragungsweg der Bartflechte. *Derm. Woch.* **79**: 1577-1579.

Désir de Fortunet. 1889. Parasites des éruptions circinées, *Lyon Méd.* **62**: 253-256.

Désir de Fortunet, & J. Courmont. 1890. Étude expérimentale sur un champignon trouvée chez l'homme dans une lésion circinée de la peau, qu'il faut considérer comme une lésion favique, *Ann. Derm. Syphiligr.* III, **1**: 239-242.

Deuchler. 1930. Trichophyton cerebriforme im Konjunctivalsekret, *Klin. Monatsbl. Augenheilk.* **85**: 649-661.

Dhayagude, R. 1931. Y a-t-il une électivité cutanée des teignes animales? *Ann. Parasitol. Hum. Comp.* **9**: 368-371.

Dixon, Hamnett A. 1925. Fungi in diseases of the skin, *Canadian Med. Ass. Jour.* **14**: 1097-1099.

Djelaleddin-Moukhtar. 1892. De la trichophytie des régions palmaires et plantaires, *Ann. Derm. Syphiligr.* **3**: 885-915.

Dodge, Carroll William. 1929. The higher plectascales, *Ann. Myc.* **27**: 145-184, *Pls. 1, 2.*

Does, J. de. 1904. Herpes tonsurans een Microsporie bij Australische paarden, *Geneesk. Tijdschr. Nederl. Indie.* **44**: 503-533, *Pls. 1, 2.*

*—. 1907. Trichophytie-epidemie von 800 Fällen bei Pferden, *Geneesk. Tijdschr. Nederl. Indie.* **47**: 358.

*—. 1920. On the viability of Epidermophyton, *China Med. Jour.* **34**: 34.

Dold, Hermann. 1919. Über die Ursache des sogenannten Honkong-fusses ("foot-tetter," "dermatitis rimosa of the toes," "dermatitis bullosa plantaris"), *Arch. Schiffs- u. Tropenhyg.* **23**: 469-471.

—. 1919. Eczematoid Epidermophyton infection in China, *China Med. Jour.* **33**: 133-138, *1 pl.*

Donato, Giuseppe. 1927. Tigna favosa generalizzata con onicomicosi, *Giorn. Ital. Derm. Sifilol.* **68**: 1055, 1056, *2 pls.*

*Doyle, A. A. 1920. Plantar ringworm, *Austral. Med. Cong. 11th Sess. Brisbane* 528.

Dreuw. 1903. Ein neuer Nagel-parasit, *Monatsh. Prakt. Derm.* 36: 341-360.

Drouin, V. & L. Renon. 1896. Note sur une mycose cutanée innomée du cheval, *C. R. Soc. Biol.* 48: 425-428.

*Dubini. 1842. Sulla natura vegetabile della tigna vera o favosa, *Gaz. Med. Milano.* 65-68.

DuBois. 1912. Parasite cryptogamique des dermatoses erythrématosquameuses du type pityriasis rosé de Gibert, *Ann. Derm. Syphiligr.* V, 3: 32-39, *Pls. 1-3.*

—. 1923. Trichophytie de l'anus, *Ann. Derm. Syphiligr.* VI, 4: 526-528.

—. 1929. Trichophytie spontanée de la souris grise avec quelques considérations sur l'évolution naturelle de l'infection, *Ann. Derm. Syphiligr.* VI, 10: 1359-1368.

Duclaux, Émile. 1886. Sur le Trichophyton tonsurans, *C. R. Soc. Biol.* 38: 14-16.

Dudumi, V. 1913. Beitrag zur Kenntnis des Eczema marginatum (Hebra) oder Epidermophytia inguinalis Sabouraud, *Derm. Zeitschr.* 20: 1082-1110, *15 figs.*

Dufougeré, W. 1921. Les dermatomycoses de la Guyane Francaise, *Bull. Soc. Path. Exot.* 14: 354-357.

Egyedi, Henrik. 1922. Zur Reinkultivierung der pathogenen Schimmelpilze, *Zentralbl. Bakt.* I, 87: 562-564.

Ehara, Ichiro. 1927. Impfversuche von verschiedenen Trichophytonarten an Kaninchen, *Jap. Jour. Derm. Urol.* 27: *3 figs.* [60.]

Eidam, Eduard. 1882. Entwickelungsgeschichte der Askomyceten, *Bot. Centralbl.* 3: 2: 106, 107.

—. 1883. Zur Kenntnis der Entwickelung bei den Ascomyceten, *Beitr. Biol. Pfl.* 3: 377-434, *Pls. 19-23.*

Emmons, C. W. 1931. Observations on Achorion gypseum, *Mycologia* 23: 87-95, *Pl. 9, 10.*

—. 1932. Pleomorphism and variation in the dermatophytes, *Arch. Derm. Syphilol.* 25: 987-1001, *5 pls.*

Engelhardt, Willy. 1923. Die pathogenen Hyphomyceten der Giessener Gegend, *Arch. Derm. Syphilis* 144: 251-259.

—. 1923. Endotoxin- und Ektotoxinwirkung von Trichophytonpilze im menschlichen Körper und deren therapeutische Verwertung, *Derm. Woch.* 77: 1193-1198.

Engelhardt, Willy & H. Schöbel. 1926. Ein Beitrag zur Epidemiologie der Trichophytie, *Krankheitsforschung* 2: 175-185.

Epstein, Stephan. 1930. Beiträge zur Epidemiologie und Therapie der Microsporie, *Arch. Derm. Syphilis* 162: 9-18.

—. 1931. Untersuchungen über die Pilzarten der Dermatomykosen Schlesiens, *Arch. Derm. Syphilis* 163: 126-134.

Epstein, Stephan & Selma Grünmandel. 1930. Untersuchungen über spontane Abheilung von oberflächlichen Trichophytien, *Arch. Derm. Syphilis* 161: 395-428, *14 figs.*

Ercolani, G. B. 1875. Dell'onychomycosis dell'uomo e dei solipedi, *Mem. R. Accad. Sci. Ist. Bologna.* III, 6: 363-381, *1 pl.* [condensed in *Archivio Med. Vèt.* 1: 5-21, 1876].

Escomel, Edmundo. 1919. Una micosis en roedores del género Mus en la campiña de Arequipa, *Anales Fac. Med. Lima* 3: 190-192, *2 pls.*

—. 1924. Essai sur la parasitologie d'Arequipa (Pérou), *Bull. Soc. Path. Exot.* 17: 906-925.

Fabiani, G. 1932. Influence de la vaccination du milieu et de l'addition d'antivirus sur la croissance d'Achorion Schoenleini, *C. R. Soc. Biol.* 109: 403, 404.

Falchi, G. 1924. Osservazioni diagnostiche e terapeutiche sulla tricofitina Pollacci (tineatoxin), *Giorn. Ital. Mal. Ven. Pelle* 65: 716-730. [Also *Ist. Sieroterapico e Vaccinogeno Toscana, Siena* (8 pp.) *1 pl.*, 1924.]

*—. 1926. Fenomeni immunitari nelle dermatomicosi, *Boll. Soc. Med. Chirurg. di Pavia* 1: 939.

*—. 1926. Tricofitide con cultura del sangue circolante di Trichophyton plicatile, *Boll. Soc. Med. Chirurg. di Pavia* 1: 489.

—. 1932. Recherches sur les dermatomycoses. 1. À propos du polymorphisme de certains dermatophytes, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 4: 80-87. 2. Sur la possibilité de demontrer la presence d'éléments mycéliaux dans l'exsudat des trichophyties inflammatoires (folliculites, kerion), *Ibid.* 4: 88-92.

Farley, David L. 1920. The use of gentian violet as a restrainer in the isolation of pathogenic molds, *Arch. Derm. Syphilol.* 2: 459-465, *2 figs.*

—. 1920. The cultivation of Epidermophyton inguinale, *Arch. Derm. Syphilol.* 2: 466-469, *2 figs.*

—. 1921. The viability of ringworm material in dry cutaneous material, *Arch. Derm. Syphilol.* 3: 759.

Favera, G. B. dalla. 1909. Sur l'état actuel des trichophyties de la province de Parme Italie, *Ann. Derm. Syphiligr.* IV, 10: 433-451. [Sabouraud, R. 1909. À propos du travail de M. dalla Favera sur l'état. . . . *Ibid.* IV, 10: 508-517. Favera, G. B. dalla. 1909. Réponse à la critique du Dr. Sabouraud á l'occasion de mon travail. ''Sur l'état. . . .'' *Ibid.* IV, 10: 653-656.]

Fayet, Pierre Antoine. 1925. Traitement et prophylaxie des teignes chez le cheval [Trichophyton discoides], *Thèse Doct. Méd. Vét., Paris* 50: 48 pp.

Fernet, P. & P. Boyer. 1933. Le traitement externe des épidermomycoses, *Progrès Méd.* 1933: 2088-2091.

Fidanza, Enrique P. 1929. Sur l'emploi d'une nouvelle préparation d'iode (iodisan) dans le traitement des trichophyties suppurées de la barbe, *Ann. Derm. Syphiligr.* VI, 10: 731-738.

*Finkelstein, J. A. 1922. Zur Methodik der Aussaat der Dermatomyceten, *Moskau. Med. Jour.* : 43.

*Finkelstein, J. A. & Sigalowa. 1924. Zur Charakteristik der von Kindern der Stadt und des Governments Moskau gezüchteten Dermatomyceten, *Venereol. u. Dermatol.* : 65.

Finnerud, Clark W. 1925. A study of a generalized eruption caused by Microsporon Audouini. Lichen microsporicus, *Brit. Jour. Derm. Syphilis* 37: 63-83, *Figs. 1-15.*

Fiocco, G. B. 1910. Le trichofitie a Venezia, *Giorn. Ital. Mal. Ven. Pelle* 51: 181-201, *2 pls.*

—. 1925. Varietà non comune di Trichophyton pseudo-violetto (Ardesiaco), *Giorn. Ital. Derm. Sifilol.* 66: 609-611.

Fischer, Fritz. 1910. Eine neue Trichophytonart. (Trichophyton griseum), *Verhandl. Berliner Derm. Ges.* 1909-10: 112.

Fischer, Willy. 1913. Das Trichophyton gypseum asteroides und zwei neue Vertreter dieser gruppe, griseum und radioplicatum, *Derm. Woch.* 57: 1395-1406, *Pl. 11.*

—. 1913. Über Mäusefavus beim Menschen, *Berlin. Klin. Woch.* 50: 2285-2287, *8 figs.*

—. 1914. Studien über Dermatomykosen in Berlin, *Derm. Woch.* 59: 1391-1405, *Pl. 11.*

—. 1915. Eine in Krankhäusern epidemisch auftretende Fadenpilzerkrankung der Haut. (Eczema marginatum Hebra), *Deutsch. Med. Woch.* 41: 1422-1424.

—. 1917. Das Trichophyton granulosum als Erreger menschlicher Trichophytie, *Derm. Woch.* 65: 687-698.

—. 1917. Der Einfluss des Krieges auf die Dermatomykosen und ihre Pilzflora, *Deutsch. Med. Woch.* 43: 938-941.

—. 1918. Sycosis parasitaria durch ein neues Mikrosporum vom Tiertype (Microsporum xanthodes), *Derm. Woch.* 66: 241-247, *3 figs.*

—. 1919. Über das Auftreten der Mikrosporie in Berlin und ihren Erreger, eine neue Varietät des humanen Typs, *Berlin. Klin. Woch.* 56: 996-998.

—. 1919. Statistische Beiträge zur Trichophytieepidemie, *Derm. Woch.* 68: 145-150.

—. 1921. Studien und Betrachtungen über die Berliner Microsporieepidemie, *Acta Dermato-Vener.* 2: 35-68, *Pl. 3-5.*

—. 1928. Favus beim Kanarienvogel (Achorion passerinum), *Derm. Woch.* 87: 1359-1361, *2 figs.*

Flarer, F. 1931. Ricerche cliniche e sperimentali sui fattori etiopatogenetici di alcune epidermomicosi, *Arch. Ital. Derm. Sifilogr. Venereol.* 7: 415-478, *11 figs.*

Fonseca, Olympio Oliveiro Ribeyro da. 1924. Sobre a etiologia do chimbêrê, dermatose endemica dos indios do rio São Miguel, *Sciencia Med.* 2: 615-617, *2 pls.*

—. 1925. Sur l'étiologie du chimbéré, nouveau type de dermatose endémique des Indiens du fleuve S. Miguel, *C. R. Soc. Biol.* 92: 305, 306.

—. 1930. Affinidades parasitologicas e clinicas entre o tokelau da Asia e da Oceania e o chimbêrê dos indigenas de Matto-Gross, *Rev. Med. Cir. Brasil.* 38: 281-311, *4 pls.*

Fonseca, Olympio Oliveiro Ribeyro da & A. Simão Levy. 1930. Una epidemia de tonsurante infantil no Rio de Janeiro, *Rev. Med. Cir. Brasil,* 37: 136-141, 4 *figs.*

Forconi, Giovanni. 1927. Una dermatomicosi umana da ifomicete esotico, *Atti R. Accad. Fisiocrit. Siena.* X, 1: 515-517.

Forster, Milton H. 1914. Favus and ringworm of the nails, *Jour. Amer. Med. Ass.* 63: 640-645, *20 figs.*

Foutrein, Auguste Lilas. 1895. Sur une épidémie de trichophytie, *Thèse Fac. Med. Pharm. Bordeaux* 43: 1-56.

Fox, Howard. 1926. Ringworm of the scalp in an adult, *Arch. Derm. Syphilol.* 13: 398-400.

—. 1927. Some fungous infections of the skin and its appendages, *Atlantic Med. Jour.* 30: 273-278.

Fox, Howard & Richard W. Fowlkes. 1925. Ringworm of the scalp in adults, *Arch. Derm. Syphilol.* 11: 446-465.

Fox, T. Colcott. 1897. The biology of the ringworm, *Brit. Med. Jour.* 2: 876-878.

—. 1908. Further contribution to the study of the endothrix trichophyta flora in London, *Proc. Roy. Soc. Med.* 2: Derm: 49-68.

Fox, T. Colcott & Frank R. Blaxall. 1896. An inquiry into the plurality of fungi causing ringworm in human beings as met with in London, *Brit. Jour. Derm. Syphilis* 8: 241-255, 291-308, 337-359, 377-384.

—. 1898. Notes on two cases of tinea circinata, *Brit. Jour. Derm. Syphilis* 10: 37-44, *1 pl.*

Fraser, A. Reith. 1922. A specialized scalp condition peculiar to the syphilitic native of South Africa, *Brit. Jour. Derm. Syphilis* 34: 267-274, *2 pls.*

Frazier, Chester N. 1926. Tinea capitis in a Chinese orphanage, *China Med. Jour.* 40: 558-562.

Frazier, Chester N., T. J. Kurotchkin & Jui-Wu Mu. 1930. Types of Dermatomyc[et]es isolated from scalp infections in Peiping, *Nat. Med. Jour. China* 16: 168-170.

Frèche, & E. Cazenave. 1925. Teigne tondante avec épidermophytie eczématiforme (Trichophyton acuminatum) chez une vieille femme de 76 ans, *Ann. Derm. Syphiligr.* VI, 6: 341-344.

Frédéric, J. 1902. Beitrag zur Frage der Mikrosporie, *Arch. Derm. Syphilis* 59: 43-56.

Fried, S. M. & M. B. Segal. 1928. Beiträge zur experimentellen auf hämatogenem Wege hervorgerufenen Dermatomykose mit Berücksichtigung der Zirkulationsdauer der Parasiten in Blutkreislauf, *Derm. Woch.* 87: 1426-1434.

—. 1929. The hematogenous production of dermatomycoses: experimental studies, *Arch. Derm. Syphilol.* 19: 98-104.

Friedberger, 1876. Herpes tonsurans bei einem Hunde mit Uebertragung auf den Menschen, *Arch. Wiss. Prakt. Thierheilk.* 22: 369-400, *Pl. 3.*

Friedreich, N. 1858. Favus bei der Maus, *Arch. Path. Anat. Physiol.* [Virchow] 13: 287, 288.

Froilano de Mello, Indalencio. 1917. Trichophyton Viannai n. sp., the infecting agent in a case of dermatomycosis, *Indian Jour. Med. Res.* 5: 222-233, *Pl. 34, 7 figs.*

*—. 1919. O Trichophyton rosaceum Sab. deve existir no Norte de Portugal, *A Med. Moderna.*

—. 1921. Epidermophyton salmoneum n. sp. d'une épidermophytie inguinale dans l'Inde portugaise, *C. R. Soc. Biol.* 84: 239, 240.

Froilano de Mello, Indalencio, & S. Paes. 1923. Sur un Trichophyton à culture faviforme agent d'une teigne de cuir chevelu, *Cong. Med. Trop. de l'Afrique occidentale, Loanda.* 10 pp., *2 pls.*, also **Rev. Med. Angola* 505-513, 1923.

Frühwald, Richard. 1924. Über eine Mikrosporieendemie in Chemnitz, *Derm. Woch.* **78**: 333-338.

Fuchs, H. 1916. Abnormes Haarwachstum nach tiefer Trichophytie, *Arch. Derm. Syphilis* **121**: 945, 946, *Pl. 40.*

Fuhs, Herbert. 1923. Über die Audouinische Mikrosporie mit besonderer Berücksichtigung der letzten Wiener Mikrosporieepidemie, *Acta Derm. Ven.* **4**: 207-264, 356-401.

Fujii, Seijiroh. 1931. Über die durch neuentdeckte Dermatophyten hevorgerufene Trichophytie der Haut, sowie über Trichophytien in Shikoku, *Jap. Jour. Derm. Urol.* **31**: 305-357, *Pl. 25, 26.* [German summary 11-14.]

—. 1931. Über Pompholyx und pompholyxartige Erkrankungen, *Jap. Jour. Derm. Urol.* **31**: 959-983, *15 figs.* [German summary 71, 72.]

Furthmann, W. & C. H. Neebe. 1891. Vier Trichophytonarten, *Monatsh. Prakt. Derm.* **13**: 478-488.

*Fuse, S. 1924. On fungal skin lesions in Kyushu, *Jap. Jour. Derm. Urol.* **24**.

Galewsky. 1917. Über das gehäufte Auftreten von Ekzema marginatum (Epidermophytie) in Lazaretten und bei der Truppe, *München. Med. Woch.* **64:1**: 472, 473.

—. 1918. Über das gehäufte Auftreten der Trichophytie, *Derm. Woch.* **66**: 145-153.

Ganzoni, Moritz. 1921. Ueber familiäres Auftreten von Pilzerkrankungen der Haare, Haut und Nägel bei einer aus Polen eingewanderten Familien verursacht durch Trichophyton violaceum, *Schweiz. Med. Woch.* **51**: 722-725.

Garibaldi, Giuseppe. 1909. Il sangue dei tignosi innanzi allo Achorion, *Giorn. Ital. Mal. Ven. Pelle* **50**: 336, 337.

Gaté, J., G. Massia & Treppoz. 1931. Favus avec lésions cutanées. Aspect de l'Achorion dans les squames, *Bull. Soc. Franc. Derm. Syphiligr.* **38**: 146, 147.

Gavazzeni, G. Alessandro. 1924. Le tigne di Bergamo e Provincia, *Giorn. Ital. Mal. Ven. Pelle* **65**: 1295-1301.

Géber, Hans. 1913. Favus bei Neugeborenen, *Arch. Derm. Syphilis* **114**: 101-110.

Gilman, Robert L. 1933. The incidence of ringworm of the feet in a university group. Control and treatment, *Jour. Amer. Med. Ass.* **100**: 715-717.

Glaser, F. 1908. Eine Mikrosporie-Epidemie, *Berliner Klin. Woch.* **45**: 1086, 1087, *2 figs.*

—. 1908. Die Mikro- und Makrosporie der Kinderkopfe (Kopftrichophytie der Kinder), *Berliner Klin. Woch.* **45**: 2013-2016, *7 figs.*

Glasser, René. 1929. Contribution à l'étude du Trichophyton gypseum granulosum, *Thèse de Strasbourg,* 84 pp., *7 pls.*

—. 1934. Deux cas de favus en peau glabre, *Bull. Soc. Franç. Derm. Syphiligr.* **41**: 195-197.

Glaze, Andrew L. 1924. Treatment of epidermomycoses of feet and hands, *Southern Med. Jour.* **17**: 643-647.

*Gluchovzov, B. 1927. Zur Kasuistik und Ätiologie der Dyshidrosis, *Vestnik Russki Dermatologii.* **5**: 355.

Gluge, Gottlieb & J. d'Ukedem. 1857. De quelques parasites végétaux développés sur des animaux vivants, *Bull. Acad. R. Belgique.* **II, 3**: 338-352, *Pls. 1, 2.* [Reprinted, *Ann. Méd. Vét.* **1858**: 362-372, 1858.]

Goddard, David R. 1934. Phases of the metabolism of Trichophyton interdigitale Priestley, *Jour. Infect. Dis.* **54**: 149-163.

Goehl, Elizabeth. 1919. Ueber "Lichen trichophyticus" oder "Lichenoide Trichophytide." *Inaug. Diss. Bonn.* 44 pp.

Golay, J. 1928. Deux cas de trichophytie faviforme généralisée, *Ann. Derm. Syphiligr.* **VI, 9**: 508-514, *4 figs.*

Goldkraut, N. I. 1915. Über im Deutschen Reich autochthon entstandenen Favus, *Derm. Woch.* **61**: 1066-1076, *2 figs.*

Goldschmidt, W. N. 1924. A new medium for the growth and differentiation of the dermatophytes, *Brit. Jour. Derm. Syphilis* 36: 204-206.

Goldsmith, W. N. 1931. A case of erythema multiforme apparently of trichophytic origin, *Brit. Jour. Derm. Syphilis* 43: 121-125, *1 pl.*

Gonzales Urueña, Jesus. 1922. Traitement des teignes au moyen de l'acétate de thallium, *Congr. de Dermatologistes et de Syphiligraphes de la Langue Française.* **1**: 114-119.

—. 1923. Teigne tonsurante trichophytique à culture crateriforme, *Rev. Mex. Biol.* **3**: 93-119.

—. 1924. Teigne tonsurante Sabouraudite de l'adulte, *Rev. Mex. Biol.* **4**: 90-93.

—. 1928. Le traitement des teignes par l'acétate de thallium, Paris, Masson et Cie., 144 pp., *Pls. 1-5.*

—. 1930. Ringworm of the soles in Mexico. Clinical study, *Arch. Derm. Syphilol.* **21**: 909-915, *4 figs.*

Gonzales Urueña, Jesus & Isaac Ochoterena. 1932. Épidémie familiales de tondantes à Trichophyton pilosum, *Ann. Derm. Syphiligr.* VII, 3: 244-254.

Goodman, Herman. 1931. Tinea, the second most prevalent disease of the skin, *Arch. Derm. Syphilol.* **23**: 872, 873.

Gottschalk. 1925. Zur Diagnose und Therapie der Mikrosporie, *Deutsch. Med. Woch.* **51**: 870, 871.

Gougerot, H. 1922. Les dyshidroses vraies (sans mycoses) et les épidermomycoses dyshidrosiformes, les cas mixtes ou dyshidroses secondairement infectées, *Congr. de Dermatologistes et Syphiligraphes de la Langue Française.* **1**: 43-45.

—. 1919. Trichophyties post-vaccinales, *Paris Méd.* **31**: 442-445.

Gougerot, H. & Jean Meyer. 1931. Pityriasis versicolor achromiant variété alba, *Bull. Soc. Franç. Derm. Syphiligr.* **38**: 46. [Case in **Arch. Clin. de St. Louis* : 773, 1929, Microsporon furfur.]

Gould, Adrian G. & Edna K. Carter. 1930. Fungistasis in ringworm of the toes and of the feet. I. Salicylic and benzoic acids, *Arch. Derm. Syphilol.* **22**: 225-231. II. Two per cent mercurochrome 220 soluble and liquor hexylresorcinolis, 1: 1,000 (St. 37). *Arch. Derm. Syphilol.* **25**: 348-352.

Gould, William J. 1931. Ringworm of the feet, *Jour. Am. Med. Ass.* **96**: 1300-1302.

Graffenried, Curt von. 1918. Beiträge zur Frage der mykotischen Dyshidrose. *Thesis, Zurich.* 44 pp., *1 pl.*

—. 1918. Beitrag zur Frage der mykotischen Dyshidrosis (Kaufmann-Wolf), *Derm. Woch.* **66**: 361-371.

Gravagna. 1921. Trichophytic cutanée de diagnostic difficile, *Ann. Derm. Syphiligr.* VI, 2: 489-493.

Grawitz, Paul. 1877. Beiträge zur systematischen Botanik der pflanzlichen Parasiten mit experimentellen Untersuchungen über die durch sie bedingten Krankheiten, *Arch. Path. Anat. Phys.* [Virchow] **70**: 546-598, *Pls. 18, 19.*

—. 1886. Über die Parasiten des Soors, des Favus und Herpes tonsurans. *Arch. Path. Anat. Phys.* [Virchow] **103**: 393-412.

*Greco, Nicolas V. 1909. Oidiomicosis epidermica tricofitoide, *Argentina Med.*

Greenbaum, Sigmund S. 1922. On the biologic properties of pathogenic molds, *Jour. Infect. Dis.* **31**: 26-31.

—. 1924. Studies in immunity in ringworm infections. I. Active acquired immunity: with note on complement fixation tests in superficial ringworm infections, *Arch. Derm. Syphilol.* **10**: 279, 280, *3 figs.* II. Active induced immunity, *Ibid.* **10**: 462-470, *3 figs.*

Greenwood, Arthur M. 1922. Epidermophytosis, *Boston Med. Surg. Jour.* **187**: 176-180.

—. 1923. Report on cultures of parasitic fungi, *Arch. Derm. Syphilol.* **8**: 81, 82.

Greenwood, Arthur M. & Ethel M. Rockwood. 1930. The skin in diabetic patients, *Arch. Derm. Syphilol.* **21**: 96-107, *10 figs.*

*Gregorio y Garcia Serrano, Eduardo de. 1927. Favus cutaneo de forme tricofitoide, producido por el Achorion quinckeaneum, *Actas Dermo-sifiliograficas.* **19.**

—. 1929. Contribution à l'étude des épidermomycoses, *Ann. Derm. Syphiligr.* VI, **10:** 512-532.

—. 1931. Dos nuevos tricofitones todavía non descritos encontrados en nuestro pais, *Actas Dermo-Sifiliograficas.* **23:** 710-718, *6 figs.* [*Clinica y Laboratorio* **101:** 1-11.]

—. 1934. Tricoficia de los bóvidos. *Actas Dermo-Sifiliograficas* [1-7, *7 figs.*]

Griff, Fanny & M. M. Itikin. 1930. Zur Ätiologie der Dyshidrosen. *Acta Derm. Venereol.* **11:** 508-526, *6 figs.*

Grigorakis, Leonidas. 1924. Contribution à l'étude des dermatophytes, *C. R. Acad. Sci.* **179:** 1423-1425.

—. 1925. Recherches cytologiques et taxonomiques sur les dermatophytes et quelques autres champignons parasites, *Ann. Sci. Nat. Bot.* X, **7:** 165-444, *Pls. 1-28.* [Reprinted as doctoral thesis.]

—. 1926. Le pléomorphisme de dermatophytes, *C. R. Ass. Franç. Av. Sci.* **50:** 322-324.

—. 1926. Les dermatophytes du genre Aleurisma, *C. R. Ass. Franç. Av. Sci.* **50:** 324. [Title only, no text.]

—. 1927. Corps propagateurs et systématiques des dermatophytes du genre Spirallia (Trichophyton microïdes Sabouraud) ou Sabouraudites Langeron et Ota, *C. R. Soc. Biol.* **97:** 760, 761.

—. 1928. Contribution à l'étude des teignes et de leurs parasites, *Thèse Fac. Méd. Lyon.* 125 pp.

—. 1929. L'étude des dermatophytes et les critiques de MM. Sabouraud et Langeron, *Ann. Parasitol. Hum. Comp.* **7:** 83-87.

—. 1929. Dermatophytes et dermatomycoses, *Ann. Derm. Syphiligr.* VI, **10:** 18-53, *16 pls.*

—. 1929. Les syndromes mycosiques de la peau et les critiques du Dr. Sabouraud, *Ann Derm. Syphiligr.* VI, **10:** 386-394.

*—. 1931. Le diagnostique des champignons des teignes d'après leurs cultures, *Marseille Méd.* **1931:** 408.

—. 1931. L'action des milieux glycérinés sur le mycélium dégradé par le pléomorphisme, *C. R. Soc. Biol.* **108:** 94-96.

—. 1932. Morphologie et taxonomie du Spiralia mentagrophytes ou champignon à cultures plâtreuses. *C. R. Soc. Biol.* **109:** 186-188.

—. 1933. Sur une nouvelle espèce de favus, Arthrosporia Gougeroti, *C. R. Soc. Biol.* **114:** 258, 259.

—. 1933. D'apres quelles formes botaniques devons-nous classer les cultures glabres? *C. R. Soc. Biol.* **114:** 260-262.

—. 1933. Sur un nouveau milieu de conservation des dermatophytes (Pléomorphisme, caractère acquis, spécificité tissulaire), *C. R. Acad. Sci.* **196:** 60-62.

Gruby, David. 1841. Mémoire sur une végétation qui constitue la vraie teigne, *C. R. Acad. Sci.* **13:** 72-75.

—. 1841. Sur les mycodermes qui constituent la teigne faveuse. *C. R. Acad. Sci.* **13:** 309-312.

—. 1842. Sur une espèce de mentagre contagieuse résultante du développement d'un nouveau cryptogame dans la racine des poils de la barbe de l'homme, *C. R. Acad. Sci.* **15:** 512, 513.

—. 1842. Über Tinea favosa, *Arch. Anat. Physiol.* [Müllers] **1842:** 22-24.

—. 1843. Recherches sur la nature, la siège et le développement du porrigo decalvans ou phytoalopécie, *C. R. Acad. Sci.* **17:** 301-303.

—. 1844. Recherches sur les cryptogames qui constituent la maladie contagieuse du cuir chevelu décrite sous le nom de teigne tondante (Mahon) herpes tonsurans (Cazenave), *C. R. Acad. Sci.* **18:** 583-585.

Grütz, Otto. 1922. Die Flora der Dermatomykosen in Schleswig Holstein, *Derm. Zeitschr.* 36: 254-269.

—. 1924. Über Variabilität pathogener Hautpilze, *Centralbl. Bakt.* I, 93: 268-273.

Guéguen, Fernand. 1904. Les champignons parasites de l'homme et des généralités, classification, biologie, technique, clefs analytiques, synonymie, diagnoses animaux, histoire parasitologique, bibliographie, Paris, xvii, 299 pp., *12 pls.*

—. 1908. Sur la position systematique des Achorions et de Oospora à Mycélium fragmenté, *C. R. Soc. Biol.* 64: 852-854.

—. 1910. Sur la non-spécificité botanique des champignons des teignes, *C. R. Soc. Biol.* 69: 495-497.

—. 1911. Microsporum depauperatum, nouveau parasite cutané. Considérations sur la systematique des champignons des teignes, *Arch. de Parasitol.* 14: 426-446.

—. 1911. Caractères généraux des teignes humaines et animales, *Rev. Sci.* 49: 201-207, *Figs. 19-27.*

—. 1911. Affinités botaniques des champignons des teignes. Traitement actuel de ces affections, *Rev. Sci.* 49: 353-358, *Figs. 33-35.*

Guiart, J. 1929. À propos des travaux récent sur la classification des dermatophytes, *Ann. Parasitol. Hum. Comp.* 7: 80-82.

Guiart, J. & Leonidas Grigorakis. 1928. La classification botanique des champignons des teignes, *Lyon Méd.* 141: 369-378.

Gunderson, Edvard. 1926. Pilzuntersuchungen über das Problem der Gramfärbung, *Arch. Derm. Syphilis* 151: 171-175, *5 figs.* Also *Derm. Woch.* 82: 45, 46.

Gunsett, A. 1902. Eine Kleine Epidemie von Mikrosporon Audouini in Strassburg, *Arch. Derm. Syphilis* 59: 77-86, *1 fig.*

Guth, Arthur. 1914. Über lichenoide (Klein papulöse, spinulöse) Trichophytie, *Arch. Derm. Syphilis* 118: 856-891.

Gutmann, C. 1919. Zur Frage der Dermatomykosen, *Derm. Woch.* 69: 580-583, 593-598.

—. 1921. Bemerkungen zur Röntgenbehandlung der Mikrosporie und Trichophytie der Kinderköpfe und zur Pilzflora der letzteren Affektion, *Derm. Woch.* 73: 1123-1126.

Guy, W. H. & Fred M. Jacob. 1923. Differential diagnosis of parasite infections of hands and feet, *Pennsylvania Med. Jour.* 26: 384-388.

—. 1925. Epidermophytosis, a sequel to vaccination, *Arch. Derm. Syphilol.* 12: 233, 234.

Habermann, R. & O. Dahmen. 1927. Über Favide und Leukoderma favicum nebst Bemerkungen über Pathogenese und Systematik der Leukoderme, *Derm. Zeitschr.* 50: 249-260.

Halgand, Félix. 1904. Étude sur les trichophyties de la barbe, *Arch. de Parasitol.* 8: 590-622.

*Halkin, H. & S. Lapière. 1926. Une épidémie de Microsporon felineum, *Ann. Soc. Méd. -Chirurg. Liège.* 59: 142.

Hallows, Norman. 1922. The control of tinea cruris, *Lancet* 2: 791, 792.

Hammerschmidt, Johann. 1922. Studien zur Morphologie und Biologie der Trichophytiepilze, I, *Arch. Hyg.* 90: 1-22, *1 pl., 4 figs.*

Hanawa, Sh. 1913. Histologische Untersuchungen über Trichophytie-Heilung und Allergie beim Meerschweinchen, *Derm. Woch.* 57: 939-955.

—. 1913. Über die Beziehung der Reizbarkeit der menschlichen und tierischen Haut zu ihrem Pigmentgehalt, *Derm. Zeitschr.* 20: 761-777.

Hanawa, Sh. & S. Nagai. 1917. Zur Kenntnis der Tinea imbricata mit besonderer Berücksichtigung ihres Erregers, *Jap. Zeitschr. Derm. Urol. Ergänzungsband*: 47-84, *Pls. 4-8.* [Festschrift Keizo-Dohi.]

Hare, J. G. & P. Tate. 1927. On the fungi causing ringworm in children attending London County Council School, *Jour. Hyg.* 27: 32-36.

Harnach, R. 1927. Étude expérimentale sur l'immunité et l'allergie consécutives à la teigne herpétique dan l'espèce bovine, *C. R. Soc. Biol.* 96: 1092, 1093.

Harris, John H. & George M. Lewis. 1930. Trichophyton purpureum (Bang) as a deep invader of the skin, *Arch. Derm. Syphilol.* **22**: 1-6.

Harris, L. Herschel. 1907. Ringworm and its treatment: technique of x-ray treatment, *Australasian Med. Gaz.* **26**: 510-514, *2 figs.*

Harry, Felix. 1922. Über eine durch das Achorion violaceum hevorgerufene Erkrankung des behaarten Kopfes, *Derm. Woch.* **75**: 726-729.

—. 1923. Zur Kenntnis der glatten Trichophytien, *Derm. Woch.* **76**: 500-503.

Hartmann, E. 1926. Über ein gemeinsames Vorkommen von Cephalosporium und Trichophyton gypseum, *Derm. Woch.* **82**: 565-569.

Hartzell, M. B. 1915. Eczematoid ringworm, particularly of the hands and feet, *Amer. Jour. Med. Sci.* **149**: 96-101, *1 fig.*

—. 1920. Two unusual cases of ringworm, one of them due to a fungus (Trichophyton rosaceum) producing pink cultures, *Arch. Derm. Syphilol.* **1**: 1-7, *1 pl., 3 figs.*

Harz, C. O. 1871. Einige neue Hyphomyceten Berlin's und Wien's nebst Beiträgen zur Systematik derselben, *Bull. Soc. Imp. Nat. Moscou* **44**: 88-147, *Pls. 1-5.*

*Hasegawa, Munenori. 1927. Über die Dermatomykosen in Formosa mit besonderer Berücksichtigung ihrer Erreger, *Jap. Jour. Derm. Urol.* **27**: 103-152 [7.].

Hashimoto, T., T. Irizawa & M. Ota. 1930. Une variété blanche du Sabouraudites ruber Ota et Langeron, 1923 (Epidermophyton rubrum Castellani 1909), *Jap. Jour. Derm. Urol.* **30**: 243-251 [French Summary 31, 32].

*Hashimoto, T. & T. Ishibashi. 1924. On favus in Manchuria and Mongolia, *Jap. Jour. Derm. Urol.* **24**.

Hashimoto, T., T. Ishibashi, H. Iwatake & Masso Ota. 1927. Le favus en Mongolie et son champignon causal: Grubyella Schoenleini var. mongolica n. var., *Jap. Jour. Derm. Urol.* **27**: 386-409, *16 figs.* [33-35.]

Hazen, H. H. 1924. Eczematoid ringworm, *Jour. Am. Med. Ass.* **83**: 1123-1126.

Hebra. 1869. Über den Befund von Pilzen bei Eczema marginatum, *Arch. Derm. Syphilis* **1**: 163-167, *1 fig.*

Heidegger, Eduard. 1928. Ein Beitrag zur Färbung der Pilze von Favus und Herpes tonsurans, *Deutsch. Woch.* **87**: 1112-1114.

Heller, Julius. 1923. Zur Kasuistic seltener Nagelkrankheiten. XVIII. Nagelkrankung durch Trichophyton endothrix violaceum, *Derm. Zeitschr.* **38**: 13-15.

Henderson, Yandell. 1932. Fungus infection of the feet, fumigation of shoes with formaldehyde as a means of treatment, *Arch. Derm. Syphilol.* **26**: 710, 711.

Herxheimer, Karl & Hermann Köster. 1914. Über sekundäre lichenoide Trichophytie, *Derm. Zeitschr.* **21**: 569-573.

Highman, Walter James. 1930. Epidermophytosis and epidermophytids of the hands, *Jour. Am. Med. Ass.* **95**: 1158-1160.

Hill, N. Gray. 1928. Wood's glass and the detection of ringworm by its fluorescent properties, *Brit. Jour. Child. Dis.* **25**: 54-57.

Hodges, Robert S. 1921. Ringworm of the nails. A preliminary report of sixteen cases of onychomycosis with a cultural study of twelve of these cases due to Trichophytons, *Arch. Derm. Syphilol.* **4**: 1-28, *Figs. 1-12.*

—. 1928. Cultures of ringworm fungi on Sabouraud's proof mediums and on mediums prepared with American peptones and sugars, *Arch. Derm. Syphilol.* **18**: 852-856.

Hoffmann, Heinrich. 1928. Über eine Pilzerkrankung beim Affen hervorgerufen wahrscheinlich durch Achorion gypseum, *Derm. Woch.* **86**: 353, 354.

Hohmann, Helmut. 1931. Das Ergebnis einer Nachuntersuchung von 79 Mikrosporie-Fällen (3-10 Jahre nach der Röntgenepilation), *Röntgenpraxis* **4**: 244-248. *Diss. Univ. Köln,* 10 pp.

Hoolboom. 1927. Dhobie itch, Koetoe-aèr en aanverwante aandoeningen, *Nederl. Tijdschr. Geneesk.* **2**: 569-578.

Hopkins, J. G. & K. Iwamoto. 1923. Fermentation reactions of the ringworm fungi. I. Differentiation of the Trichophyta and allied genera from other fungi, *Arch. Derm. Syphilol.* 8: 619-624. II. Characteristics of three divisions of the Trichophyton group, *Ibid.* 8: 838-843.

Hopkins, Ralph. 1921. Eczematoid dermatitis due to a ringworm fungus, *New Orleans Med. Surg. Jour.* 74: 336-339.

Horta, Paulo. 1912. Contribuições para o estudo das dermatomicozes no Brazil. I. Microsporon flavescens n. sp. ajente duma nova tinha microsporia, *Mem. Inst. Oswaldo Cruz.* 3: 301-308, *Pl. 17.*

Hu, Ch’uan K’uei, T. J. Kurotchkin & Chester N. Frazier. 1932. Observations on the treatment of tinea capitis with thallium acetate, *Chinese Med. Jour.* 46: 23-30.

Hube, Xaverus. 1837. De morbo scrofulo, *Diss. Inaug. Berlin*, 44 pp.

Huber, O. 1909. Über die Mikrosporie-Epidemie in Schöneberg, *Med. Klin.* 5: 762-766.

—. 1910. Über das Erlöschen der Mikrosporieepidemie in Schöneberg, *Med. Klin.* 6: 664.

Hudelo, Lucien, Raimond Sabourand & Richon. 1923. Trichophytie du cuir chevelu (Trichophyton violaceum) chez une Isréalite russe de 55 ans., *Bull. Soc. Franç. Derm. Syphiligr.* 30: 76.

*Hüges. 1914. Die Mikrosporie-Epidemie in Strassburg, *Inaug. Diss. Strassburg.*

Hulsey, S. H. & F. M. Jordan. 1925. Ringworm of the toes as found in University students, *Am. Jour. Med. Sci.* 169: 267-269.

Hutchins, Miller B. 1922. A contribution to the treatment of phytosis of the feet, *Arch. Derm. Syphilol.* 6: 761-769.

Ildrim, D. 1933. Die Dermatomykosen, Favus, trichophytia und microsporia in Aserbaydshan (Transkaukasus), *Arch. Schiffs Tropenhyg.* 37: 505-508, *3 figs.*

Iliesco, C. & S. Longhin. 1930. Un cas de favus généralisé de la peau et des muqueuses, *Ann. Derm. Syphiligr.* VII, 1: 376-379, *1 fig.*

In, Keiden. 1930. A study of Dermatophyton along the shores of the lower course of the Yangtse-Kiang, *Jap. Jour. Derm. Urol.* 30: 791-809, *34 figs.*

—. 1931. Die behandlung der Dermatomykosen mit alcoh. Extrakt von Pilanzenrinde Do-Kin-Pi, *Jap. Jour. Derm. Urol.* 31: 485-500, *14 figs.* [48, 49.]

*Ito, M. 1923. Three cases of skin lesion caused by wet compression, in which Epidermophyton inguinale, Trichophyton gypseum, and T. purpurem were cultured, *Jap. Jour. Derm. Urol.* 23: 346.

Jacobi, E. 1907. Eine besondere Form der Trichophytie als Folgeerscheinung des permanenten Bades, *Arch. Derm. Syphilis* 84: 289-300, *Pls. 11, 12.*

Jadassohn, J. 1918. Über die Trichophytien (Allgemein-pathologisches und klinisches), *Berlin. Klin. Woch.* 55: 489-494.

Jadassohn, Werner. 1927. Beitrag zur Genese der Allergie bei Impfmykosen. Der Übertritt von Sporen aus dem cutanen Impfherd ins Blut mit Entwicklung von hämotogenen Hautmetastasen, *Arch. Derm. Syphilis* 153: 476-481.

—. 1928. Versuche über Pilzzüchtung auf Organen, *Arch. Derm. Syphilis* 155: 203-207.

Jadassohn, Werner & Samuel M. Peck. 1929. Epidermophytide der Hände, *Arch. Derm. Syphilis* 158: 16-27.

Jadassohn, Werner & Karl Rehsteiner. 1931. Experimentelle Hyphomyceteninfektionen am Auge (Ein Beitrag zum Problem der Organotropie), *Klin. Woch.* 10: 308-310.

Jadassohn, Werner & Adolf Stähelin. 1930. Der Einfluss der Temperatur auf das Angehen der Trichophytie bei Meerschweinchen, *Arch. Derm. Syphilis* 161: 146-148.

Jamieson, Robert C. & Adelia McCrea. 1932. Recurrence or reinfection in ringworm of the hands and of the feet, a study of the persistence of the organism in the tissues, *Arch. Derm. Syphilol.* 25: 321-333, *4 figs.*

Jauison, Hubert & L. Dufestel. 1933. Sur l’action vaccinante de lysats pancréatiques et diastasiques de dermatophytes, *C. R. Soc. Biol.* 113: 868-870.

Jauison, Hubert & Guillaud-Vallée. 1932. L’allergie mycosique dans le psoriasis, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 48: 1599-1610.

Jauison, Hubert, Guillaud-Vallée & Pecker. 1932. L'allergie mycosique dans le lichen plan, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **48**: 1592-1599.

Jauison, Hubert, de Lima, Guillaud-Vallée & Pagès. 1932. Les preuves de l'allergie mycosique intradermo-reaction et vaccination spécifique, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **48**: 1583-1592.

Jeanselme, Édouard. 1901. Le Tokelau dans l'Indochine française, *C. R. Soc. Biol.* **53**: 122, 123.

*—. 1907. Dermatologie exotique. Paris.

—. 1921. Sur quelques dermatomycoses exotiques, *Rev. Gén. Clin. Thérapeut. Jour. Praticiens.* **35**: 146-149.

Jeanselme, Édouard & Marcel Bloch. 1923. Efflorescences faviques de la peau glabre sans godets. À propos d'une petite épidémie de 5 cas, *Bull. Soc. Franç. Derm. Syphiligr.* **30**: 80, 81.

Jeanselme, Édouard, Marcel Bloch & J. Hutinel. 1923. Endémie périodique d'épidermomycose humaine et animale; trichophytie d'origine bovine; remarques pathogéniques, *Presse Méd.* **31**: 729.

—. 1923. Epidermomycose disseminée (trichophytie probable) d'origine animale, *Bull. Soc. Franç. Derm. Syphiligr.* **30**: 82, 83, *2 figs.*

Jeanselme, Édouard & René Burnier. 1923. Trichophytie suppurée des deux fesses, *Bull. Soc. Franç. Derm. Syphiligr.* **30**: 359, 360.

—. 1926. Trichophytie suppurée de la fesse, *Bull. Soc. Franç. Derm. Syphiligr.* **33**: 478.

—. 1927. Un cas de trichophytie cutanée du dos du pied, *Bull. Soc. Franç. Derm. Syphiligr.* **34**: 168.

Jeanselme, Édouard & L. Hufnagel. 1926. Sur une endémie familiale de favus poursuivant à travers trois générations, *Bull. Soc. Franç. Derm. Syphiligr.* **33**: 476, 477.

Jeanselme, Édouard & Joannon. 1927. Favus et immigration, *Bull. Acad. Méd.* **97**: 571-576.

Jesionek, A. 1921. Immunität und Allergie bei Trichophytie, *Beitr. Path. Anat. Allg. Path.* **69**: 122-142.

Jessner, Max. 1921. Zur Pathogenese des Trichophytide, *Arch. Derm. Syphilis* **136**: 416-424.

Jessner, Max & Heinrich Hoffmann. 1923. Versuche über die Beeinflussung von Trichophytonpilzen durch Serum Allergischer, *Klin. Woch.* **2**: 1959.

—. 1924. Der Einfluss des Serums Allergischer auf Trichophytonpilze, *Arch. Derm. Syphilis* **145**: 187-191.

—. 1926. Untersuchungen über subcutane Trichophyton-Inokulationen, *Arch. Derm. Syphilis* **151**: 98-105, *1 table, Figs. 1-4.*

Johan-Olsen, Olav. 1897. Zur Pleomorphismusfrage, *Centralbl. Bakt.* II, **3**: 276-284, *Pl. 4, Figs. 1-5.*

Jouveau-Dubreuil, H. 1919. Tokelau (tinea imbricata) in Szechwan, *China Med. Jour.* **33**: 223-229, *1 pl.*

Joyeux, Charles. 1912. Sur le Trichophyton soudanense, n. sp., *C. R. Soc. Biol.* **72**: 15, 16.

—. 1914. Contribution à l'étude des teignes africaines, Trichophyton soudanense, *Arch. de Parasitol.* **16**: 449-460, *Pl. 7, 6 figs.*

Joyeux, Charles & J. Duché. 1934[?]. Les classifications des dermatophytes, *Arch. Derm. Syphiligr. Clin. St. Louis* **4**: 477-497.

Kadisch, E. 1928. Einige experimentelle mykologische Fragen [90 Naturforscher- und Ärztversammlung in Hamburg 1928], *Derm. Woch.* **87**: 1893-1895. [Brief note, see *Derm. Zeitschr.* **55**: 385-396, 1929.]

—. 1929. Über das Fortkommen der pathogenen Hautpilze ausserhalb des Körpers, *Derm. Woch.* **89**: 1423-1433.

—. 1929-1930. Beiträge zur Lehre von den Dermatomykosen. I. Die rein subcutane Pilzinfektion des Meerschweinchens, *Arch. Derm. Syphilis* **158**: 344-348, 1929. II. Über den Verbleib intrakardial injizierten Pilzmaterials beim Meerschweinchen, *Ibid.* **158**: 349-353, 1929. III. Über das Wachstum von Achorion gypseum auf Meerschweinchenorganen und die Züchtungstemperatur, *Ibid.* **158**: 481-484, 1929. IV. Kaltblüterversuche mit Achorion gypseum, *Ibid.* **161**: 529-533, *1 fig.*, 1930.

—. 1930. Das Sauerstoffbedürfnis der pathogenen Hautkeime und seine Bedeutung für den Dermatotropismus, *Arch. Derm. Syphilis* 162: 462-472, *5 figs.*

—. 1930-1931. Disinfektionsversuche mit Pilzen (Achorion gypseum), *Derm. Woch.* 91: 1771-1779, 1930; 93: 1433-1442, 1931.

—. 1933. Der Einfluss von Temperatur und Sauerstoff auf die Lokalisation der Infektionen. Wägende Untersuchungen an Fadenpilzen, Untersuchungen mit dem Pulfrich Photometer an Hefen. Modifikation des Pulfrich Photometers, *Arch. Derm. Syphilis* 168: 438-475, *10 figs.*

Kadisch, E. & A. Loewy. 1931. Über den Verlauf der Infektion mit Achorion gypseum im Höhenklima. Ein Beitrag zur Frage des Sauerstoffbedürfnisses der Fadenpilze, *Arch. Derm. Syphilis* 163: 149-157, *11 figs.*

*Kambayashi, Toyoaki. 1919. Ein Beitrag zur Studie der Pilzarten bei Trichophytonerkrankungen in Japan, *Jap. Zeitschr. Derm. Urol.* 19: 491.

*—. 1920. *Jap. Zeitschr. Derm. Urol.* 20: 1.

*—. 1921. Über eine neue Spezies von Microsporon: Microsporon japonicum Dohi et Kambayashi (Oidium microsporicum japonicum var. nov.) *Jap. Zeitschr. Derm. Urol.* 21: 433-462.

*—. 1923. Über Enzymenwirkung bei einigen Hautkrankheiten erzeugenden Fadenpilzen, *Jap. Jour. Derm. Urol.* 23: 85.

*—. 1923. Cases of kerion celsi and trichophytia profunda and on their germs, *Jap. Jour. Derm. Urol.* 23: 348.

—. 1932. Botanische Untersuchungen über Japanische Fadenpilze, die auf der Menschenhaut parasitieren, II, Microsporon japonicum, *Bot. Mag. Tokyo* 46: 751-771, *25 figs.*

*Kambayashi, Toyoaki & A. Tokuda. 1927. Contribution to the study of the exciter of Trichophytia in Riukiu, *Jap. Jour. Derm. Urol.* 27: 959.

Kapuscinski, Stanislaw. 1925. Sur la biologie des teignes, *Rev. Franç. Derm. Vénéréol.* 1: 309-319 [also **Medycyna Doswiadczalna i Spoleszna* 4: 302].

Karrenberg, Carl Ludwig. 1926. Über Differenzen im kulturellen Aussehen von Pilzen aus Haut und allergischem Allgemeinexanthem (zugleich ein Beitrag zur Frage der Variabilität), *Arch. Derm. Syphilis* 156: 150-157.

—. 1927. Allgemeinexanthem oder generalisierte Epidermophytie mit dem Epidermophyton Kaufmann-Wolf als Erreger, *Derm. Woch.* 85: 1189-1195.

*—. 1927. Züchtung und Definition pathogener Pilze mittels Grützscher Nährboden, *Mitt. f. Ärzte* [Knoll].

*—. 1928. Sobre algunas novedades en dermatología—nuevos medios de cultura. *Ecos Españoles de Dermatología y Sifiliografía.*

—. 1928. The present state of epidermophytosis in Europe, *Arch. Derm. Syphilol.* 17: 519-532.

—. 1928. Zur Färbung pathogener Pilze, *Derm. Woch.* 87: 1715, 1716.

—. 1928. Die norddeutsche Pilzflora. Ergebnisse eigener Untersuchungen mit Bemerkungen über die Epidemiologie der Dermatomykosen, speziell in Hamburg, *Derm. Woch.* 87: 1927-1930.

—. 1928. Über eine wenig beobachtete Form der inguinalen Epidermophytie "Type erythrasmoïde" des Eczema marginatum, *Arch. Derm. Syphilis* 154: 605-610.

—. 1928. Gleichzeitige Infektion mit drei verschiedenen Trichophytonarten. Ein Beitrag zur Kasuistik der seltenen Dermatomykosen, *Arch. Derm. Syphilis* 154: 668-678.

—. 1928. Über kulturellen Nachweis erfahrungsgemäss pathogener Pilze auf klinisch gesunder Haut und über seine Beurteilung, *Arch. Derm. Syphilis* 156: 160-172.

—. 1929. Nagelepidermophytie mit positiver Kultur. Bemerkungen über die Mykologie der Nagelepidermophytie überhaupt die normale Flora der Nägel, sowie zum mikroskopischen und kulturellen Pilznachweis bei Nagelmykosen, *Arch. Derm. Syphilis* 158: 431-442.

—. 1932. Über Variabilitätserscheinungen bei pathogenen Hautpilzen, *Derm. Zeitschr.* 63: 230-238.

—. 1932. Bemerkungen zu aktuellen Fragen der Dermatomykologie II. Beiträge zur Epidemiologie der Mikrosporie, *Arch. Derm. Syphilis* 166: 14-29.

—. 1933. Bemerkungen . . . III. Beiträge zur Epidemiologie des Favus. 1. Der Favus in Bonn und Umgebnng. 2. Zur Epidemiologie des Favus in Deutschland, *Derm. Zeitschr.* 66: 198-215.

Karwowski, A. von. 1928. Ein ungewöhnlicher Fall von rezidivierender Hautgangrän in Verbindung mit Pilzinfektion der Haut, *Derm. Woch.* 86: 201-207.

*Katoh, Yutaka. 1925. On the ringworm of the scalp caused by Sabouraudites ruber (Epidermophyton rubrum Cast.) especially on its character of ''endothrix,'' *Jap. Jour. Derm. Urol.* 25: 895.

—. 1925. Study of the dermatophytes in Kiushiu and the Loochoo Islands, with special report of the observation of two new species of dermatophytes: Trichophyton coccineum and Bodinia spadix, *Trans. 6th Congr. Far Eastern Ass. Trop. Med. Tokyo*, 859-866 [also *Jap. Jour. Derm. Urol.* 26: 79-110, 196-230, 306-358, 1926].

Kaufmann-Wolf, Marie. 1914. Beitrag zur Kenntnis der Beziehung zwischen Achorion Schoenleini und Achorion Quinckeanum (Menschenfavus und Tier- bezw. Mäusefavus), *Arch. Kinderheilk.* 62: 1-11, *1 fig.*

—. 1914. Über Pilzerkrankungen der Hände und Füsse, *Derm. Zeitschr.* 21: 385-396, *Pl. 8, 9.*

—. 1916. Über die Bestimmung pathogener Hyphomyzeten (unter besonderer Berücksichtigung der Berliner Pilzflora), *Arch. Derm. Syphilis* 121: 684-696.

—. 1918. Über Latenzstadien bei einer chronischen Pilzerkrankung, *Derm. Woch.* 67: 807, 808.

*Kawasaki, Y. 1923. Ein Beitrag zur Kenntnis der Kopftrichophytie in Japan, *Jap. Jour. Derm. Urol.* 23: 923.

Kawasaki, Y. & Sh. Takahashi. 1924. Über die diagnostische Bedeutung der Trichophytinreaktion, *Jap. Jour. Derm. Urol.* 24: 13.

Kawatsuré, Shuji. 1930. Über die histologischen Veränderungen der Lymphdrüsen bei der dem Kopffavus folgenden chronischen retroaurikulären Lymphadenitis, *Arch. Derm. Syphilis* 162: 262-278.

Kegel, Arnold H. 1931. Fungi of the ''ringworm'' group isolated from handles of clubs used on miniature golf courses, *Chicago School of Sanitary Instruction, Weekly Bulletin,* January 6, 1931.

Kesten, Beatrice M., Bailey K. Ashford, Rhoda W. Benham, C. W. Emmons & M. C. Moss. 1932. Fungus infections of the skin and its appendages occurring in Porto Rico. A clinical and mycologic study, *Arch. Derm. Syphilol.* 25: 1046-1057, *5 figs.*

King, Allen D. 1932. Local responses to histamine in normal skin, in dermatophytosis, in alopecia areata and in scleroderma, *Arch. Derm. Syphilol.* 25: 840-846, *2 figs.*

Kingery, Lyle B. 1929. Thymol and cinnamon oil in the treatment of ringworm of the scalp, *Arch. Derm. Syphilol.* 20: 797-805.

Kingery, Lyle B. & Alva Adkisson. 1928. Certain volatile oils and stearoptens as fungicides, *Arch. Derm. Syphilol.* 17: 499-511, *9 figs.*

Kirby-Smith, J. L. 1927. Trichophytosis, a dermatological problem in the southern states, *Southern Med. Jour.* 20: 606-610, *6 figs.*

Kister, J. & E. Delbanco. 1918. Zur Frage der Verbreitung der Trichophytie, *Deutsch. Med. Woch.* 44: 680, 681.

—. 1921. Zur Kasuistik der Kälberflechte, *Arch. Derm. Syphilis* 130: 484-486, *3 figs.*

Kittredge, Hermann E. 1933. Trichophytosis including onychomycosis universalis simulating tinea imbricata. Report of an unusually extensive case, *Arch. Derm. Syphilol.* 27: 607-623, *6 figs.*

Klebe, Egon. 1913. Beitrag zur spezifischen Behandlung der Trichophytie, *Inaug. Diss. Hess. Ludwigs Univ. Giessen*, 31 pp.

Klehmet, W. 1919. Eine Mikrosporie-Epidemie mit eigenartigem Verhalten in Hannover, *Deutsch. Med. Woch.* **45**: 1188, 1189.

—. 1921. Die Hannoversche Mikrosporie-Epidemie und ihr Erreger, *Arch. Derm. Syphilis* **130**: 490-514, *10 figs.*

Klein, Georg & C. Aliferis. 1922. Eine Mikrosporie-Epidemie in Frankfurt a. M., *Klin. Woch.* **1**: 1652-1654.

Koch, R. 1902. Framboesia tropica und Tinea imbricata, *Arch. Derm. Syphilis* **59**: 3-8, *Pls. 1-5.*

Kogoj, Fr. 1926. Experimentelle Beiträge zur Lehre von den Dermatomykosen mit besonderer Berücksichtigung der Lokalisationsbestimmung hämatogener Infektionen, *Arch. Derm. Syphilis* **150**: 333-335.

—. 1928. Über lokal verschiedene Allergie bei Pilzerkrankungen, *Arch. Derm. Syphilis* **154**: 421-427.

—. 1928. Hämatogene Dermatomykosen nach subcutaner und intramuskulärer Infektion, *Arch. Derm. Syphilis* **154**: 462-475.

—. 1929. Über die Differenzen im Grade der Allergie bei experimentellen Dermatomykosen, *Arch. Derm. Syphilis* **158**: 716-723.

Kopp, Henri. 1907. Contribution à l'étude des teignes à Algériennes. Étude microscopique, saprophytique et mycologique. *Thèse École Sup. Pharm. Montpellier* **50**: 1-67.

Krösing, Rudolf. 1896. Weitere Studien über Trichophytiepilze, *Arch. Derm. Syphilis* **35**: 67-90, 163-188, *Pls. 5-10.*

Kumer, Leo. 1928. Favus, *Handbuch der Haut- und Geschlechtskrankheiten* [Jadassohn] **11**: 655-695, *10 figs.*

Kurotchkin, T. J. & F. K. Chen. 1930. A study of the etiology of Hongkong foot, *Nat. Med. Jour. China* **16**: 556-562.

—. 1931. Mycological study of tinea of the glabrous skin, *Nat. Med. Jour. China* **17**: 521-528, *6 pls., 1 fig.*

Kurotchkin, T. J. & T. L. Ch'in. 1931. Tinea of the nails in Peiping, *Nat. Med. Jour. China* **17**: 534-540, *6 pls.*

Kurotchkin, T. J. & H. L. Chung. 1930. Mycological examination of Peiping orphanages, *Nat. Med. Jour. China* **16**: 171-176, *2 pls.*

Kusanoki, F. 1912. Experimentelle und klinische Studien zur Lehre der Dermatomykosen, *Arch. Derm. Syphilis* **114**: 1-88.

—. 1913. Die Studie der Trichophytien in Japan, *Jap. Zeitschr. Derm. Urol.* **13**: 431-457, *3 figs.* [30-34] II. *Ibid.* **13**: 687-737, *18 figs.*

—. 1925. [Über Trichophytia interdigitalis] *Jap. Jour. Derm. Urol.* **25**: 335-343. [In Japanese no abstract.]

Landau, Hans. 1918. Über Disinfektionsversuche mit Trichophytiepilzen und die Massnahmen zur Bekämpfung der Trichophytie, *Med. Klinik.* **14**: 1012, 1013.

Lane, J. E. 1916. Ringworm of the hands and feet, *Boston Med. Surg. Jour.* **174**: 271-274, *2 figs.*

Langer, Erich & Ernst Rosenbaum. 1923. Über Trichophytien im Säuglings und frühen Kindesalter, *Deutsch. Med. Woch.* **49**: 1086, 1087.

Langeron, Maurice. 1928. Travaux récents sur la classification des dermatophytes, *Ann. Parasitol. Hum. Comp.* **6**: 470-476.

—. 1932. Biologie et pléomorphisme des dermatophytes sur milieux naturels, *C. R. Soc. Biol.* **109**: 366-368.

Langeron, Maurice & S. Milochevitch. 1930. Morphologie des dermatophytes sur les milieux naturels et milieux à base de polysaccharides (Note préliminaire), *Ann. Parasitol. Hum. Comp.* **8**: 422-436.

—. 1930. Morphologie des dermatophytes sur milieux naturels et milieux à base de polysaccharides. Essai de classification (Deuxième mémoire), *Ann. Parasitol. Hum. Comp.* **8**: 465-508, *Pls. 17-26, 12 figs.*

*—. 1930. Les nouvelles méthodes d'étude des dermatophytes. 6 ta Reunión Soc. Argentina Patol. Reg. del Norte, *Bol. Inst. Clin. Quirurg. Univ. Buenos Aires.*

Langeron, Maurice & Rodolfo V. Talice. 1930. Nouveau type de lésion pilaire expérimentale produite par la culture purement pléomorphique du Sabouraudites felineus, *Ann. Parasitol. Hum. Comp.* 8: 419-421.

—. 1930. Immunité produite par des souches pléomorphiques de Sabouraudites felineus, *Ann. Parasitol. Hum. Comp.* 8: 509-511.

Lanteri, Giovanni. 1931. Alcuni casi (7) di microsporia a Catania, *Arch. Ital. Derm. Sif. Ven.* 6: 355-367, *7 figs.*

Lawrence, Herman. 1918. Dermatomycosis in mice and men, *Med. Jour. Australia* 1: 146-149, *5 figs.*

*—. 1920. Epidermato-Mycosis in mice and man, *Austral. Med. Congr. 11th Sess. Brisbane 541.*

—. 1920. Epidermato-Mycosis in the mouse plague, also cases due to Demodex folliculorum, *Med. Jour. Australia* 2: 287, 288.

Lebasque, Jules. 1933. Les champignons des teignes du cheval et des bovidés, *Thèse Fac. Sci. Paris* 2272 [A 1407]: 1-132, *8 pls., 4 figs.*

Lebert, H. 1845. Physiologie pathologique ou recherches cliniques, expérimentales et microscopiques sur l'inflammation, la tuberculisation, les tumeurs, la formation du cal, etc., 2 vol. [see: Mémoire sur la teigne 2: 477-497, *Pl. 22*].

*Leblois, Ch. 1926. Documents pour servir à l'édification d'une dermatologie animale (chien et chat). Paris.

*Lefèvre. 1904. Un nouveau microsporon pathogène pour l'homme, le Microsporum du chat, *Ann. Service Dermatol. de l'hôpital St. Pierre de Bruxelles.* 1: 24.

Legge, Robert T., Lee Bonar & H. J. Templeton. 1929. Ringworm of the feet, *Jour. Am. Med. Ass.* 92: 1507, 1508.

—. 1929. Incidence of foot ringworm among college students, *Jour. Am. Med. Ass.* 93: 170.

—. 1934. Epidermomycosis at the University of California. III, *Arch. Derm. Syphilol.* 27: 12-24. IV, *Ibid.* 29: 521-525.

*Legrain, P. 1922. Recherches au sujet de l'origine mycosique et de la dyshidrose et des éruptions dyshidriformes, *Progr. Méd.* 49: 477.

Lehmann, C. F. 1930. Acute vesicular eruptions of the hands and feet, *Arch. Derm. Syphilol.* 21: 449-463.

Leonian, Leon H. 1932. Effect of position of inoculum on growth of some Trichophytons in the presence of dyes, *Arch. Derm. Syphilol.* 25: 1016-1020, *1 fig.*

Levin, Oscar L. & Seymour H. Silvers. 1931. The isolation of ringworm fungi from sweat, *Arch. Derm. Syphilol.* 23: 1094-1099.

—. 1932. The possible explanation for the localization of ringworm infection between the toes. The hydrogen ion concentration of the interdigital spaces of the feet, *Arch. Derm. Syphilol.* 26: 466-470.

Lévy, Georges & A. Sloimovici. 1926. Trichophyton remarquablement étendue à la région des deux fesses, due au Trichophyton gypseum granulosum, *Bull. Soc. Franç. Derm. Syphiligr.* 33: 740, 741.

Lewandowsky, F. 1916. Über Kerion Celsi, verursacht durch Mikrosporon Audouini nebst Bemerkungen über die in Hamburg vorkommenden Mikrosporon- und Trichophytonarten, *Arch. Derm. Syphilis* 121: 531-556, *Pl. 18.*

Lieberthal, David and Eugene Paul Lieberthal. 1934. Epidermomycosis and flatfoot, *Arch. Derm. Syphilol.* 29: 356, 357.

Lieberthal, Eugene Paul. 1928. Treatment of Microsporon infection of the scalp, *Arch. Derm. Syphilol.* 18: 97, 98.

Light, S. E. 1931. Microscopic demonstration of ringworm, results of seven hundred and thirty-three examinations, *Arch. Derm. Syphilol.* 24: 108, 109.

Lima Carneiro, A. 1923. Sur la fréquence des divers agents des dermatomycoses au Portugal, *C. R. Soc. Biol.* 88: 1326.

Lindenberg, Adolpho. 1909. Dermatomycoses brasilieras, *Brasil Med.* 23: 341-345, *2 figs.*

Lombardo, C. 1911. Ricerche sulla ipersensibilità ed immunità in alcune dermatomicosi, *Giorn. Ital. Mal. Ven. Pelle.* 52: 70-88, *2 pls.*

—. 1914. Sulla transmissibilità per eredità e per allattamento dell'allergia nelle Dermatomicosi sperimentali, *Giorn. Ital. Mal. Ven. Pelle.* 55: 405-416.

—. 1921. Pigmentazione di lesioni cutanee da dermatofiti cromogeni, *Rif. Med.* 37: 154-156.

—. 1923. Di una particolare colorazione vitale di alcuni dermatomiceti, *Giorn. Ital. Mal. Ven. Pelle.* 64: 720.

—. 1927. Ricerche sull'Epidermophyton cruris, *Giorn. Ital. Derm. Sifilol.* 68: 744-755.

Lomholt, Svend. 1932. Zwei Fälle von Epidermophytie an den Füssen mit hämatogener Aussaat von Epidermophytiden an Händen, Armen, und Beinen, *Derm. Woch.* 95: 1325-1328, *3 figs.*

—. 1932. Eczema of the feet caused by the Epidermophyton interdigitale, illustrated by an investigation on 97 students, *Acta Derm. Venereol.* 13: 432-442, *3 figs.* [tr. *L'eczema du a l'Epidermophyton interdigitale (observation de 97 étudiants), *Jour. Méd. Chirurg. Pratiques* 104: 1933].

Loomis, Elmer C. 1932. Ringworm of the scalp: treatment with thymol and oil of cinnamon, *Arch. Derm. Syphilol.* 26: 495-498.

Lourier, A. G. & M. G. Reiff. 1932. Un cas de favus généralisé de la peau avec présence d'Achorion Schoenleini dans les cultures du sang et du suc des glandes lymphatiques, *Ann. Derm. Syphiligr.* VII, 3: 912-916, *2 figs.*

Lourier, A. G. & E. Zwitkis. 1928. Herpes tonsurans, Mikrosporie und Favus der Augenbrauen und Wimpern, *Derm. Woch.* 87: 1019-1022.

Louste & Robert Rabut. 1933. Sycosis trichophytique simulant des syphilides tuberculeuses, *Bull. Soc. Franç. Derm. Syphiligr.* 40: 253.

Louste, Robert Rabut & E. Rivalier. 1933. Essais d'inoculation humaine de Trichophyton pyogène, *Bull. Soc. Franç. Derm. Syphiligr.* 40: 286-288.

Low, R. Cranston. 1908. Ringworm and favus, *Edinburgh Med. Jour. N. S.* 1: 140-152.

—. 1911. Fungus infections of the finger nails, *Edinburgh Med. Jour. N. S.* 6: 121-128, *Pls. 1-6.*

—. 1924. Some cases of trichophytides and microsporides and their connection with lichen spinulosus, *Brit. Jour. Derm. Syphilis* 36: 432-435, *1 pl.*

MacCarthy, Lee. 1925. Contribution à l'étude des epidermomycoses avec présentation de six parasites nouveaux, *Ann. Derm. Syphiligr.* VI, 6: 19-54, *Pls. 1-6, 8 figs.*

—. 1925. Sur un cas de trichophytie de la peau glabre dû à un Trichophyton nouveau, Trichophyton depressum, *Ann. Derm. Syphiligr.* VI, 6: 184-190, *Pl. 1, 3 figs.*

McCrea, Adelia. 1931. Parasitic fungi of the skin, *Jour. Trop. Med. Hyg.* 34: 204-206.

Mcfayden, Allan. 1894. A contribution to the biology of the ringworm organism, *Jour. Path. Bact.* 3: 176-183.

McGlasson, J. L. & C. F. Lehmann. 1924. Epidermophyton and Trichophyton infection of the skin, *Texas State Jour. Med.* 19: 626-632, *15 figs.*

MacKee. 1926. Extensive ringworm of the nails, *Arch. Derm. Syphilol.* 14: 483.

Macleod, J. M. H. 1917. Dhobie itch and eczematoid ringworm of the extremities, *Jour. Trop. Med. Hyg.* 20: 67-70.

McNealy, R. W. & M. E. Lichtenstein. 1929. Tineal dermatitis in traumatic surgery, *Illinois Med. Jour.* 55: 298-300.

Magalhães, Octavio de. 1923. Cogumelos pathogenicos in Pelotas, Estado do Rio Grande do Sul, *Brasil Med.* 36: 1: 138.

—. 1924. À propos des teignes observés au Rio Grande do Sul, Brésil, *C. R. Soc. Biol.* 90: 53-55.

—. 1928. Ensaios de mycologia, *Mem. Inst. Oswaldo Cruz.* 21: 173-188, *6 pls.*

—. 1934. A classifição do Trichophyton multicolor O. Magalhães e Aroeira Neves 1928, *Mem. Inst. Oswaldo Cruz* 28: 177-180.

Magalhães, Octavio de & Aroeira Neves. 1923. Contribution à l'étude des teignes au Brésil (Trichophyton multicolor n. sp.), *C. R. Soc. Biol.* 89: 769-772, *1 fig.*

—. 1927. Contribuicão ao estudo das tinhas. Trichophyton multicolor n. sp., *Mem. Inst. Oswaldo Cruz* 20: 271-284, *Pls. 145-156* [tr. Contribution à l'étude des teignes. Trichophyton multicolor n. sp. *Ibid.* 20: 285-298, 1927].

Mahon. 1829. Recherche sur la siège et la nature des teignes, 381 pp., *5 pls.*

Mailer, Boruch. 1912. Über spezifische Reaktion bei Trichophytie. *Inaug. Diss. Königsberg.* 25 pp.

Majocchi, Domenico. 1883. Sopra una nuova tricofizia (granuloma tricofitico). Studi clinici e micologici, *Boll. R. Accad. Med. Roma* 9: 220-223.

—. 1883. Nota di tecnica micologica per l'indirizzo alla diagnosi di alcune dermato-micosi, *Boll. R. Accad. Med. Roma* 9: 223, 224.

—. 1908. Alcune considerazioni clinico-critiche e ricerche sperimentali intorno al granuloma tricofitico, *Giorn. Ital. Mal. Ven. Pelle* 49: 198-209.

—. 1910. Ulteriori osservazioni cliniche e ricerche sperimentali sul granuloma tricofitico, *Giorn. Ital. Mal. Ven. Pelle* 51: 206-216.

—. 1920. Contribuzione clinica istologica e micologica sul granuloma tricofitico, *Giorn. Ital. Mal. Ven. Pelle* 61: 397-403.

—. 1926. Associacione del granuloma trichophyticum col Kerion Celsi e indipendenza di sviluppo delle due forme tricofitiche sullo stesso soggetto (Nota prev.), *Giorn. Ital. Derm. Sifilol.* 66: 250-253.

Mallinckrodt-Haupt, Asta v. 1927. Der Fettstoffwechsel der Hautpilze I. Das Fettspaltungsvermögen der lebenden Pilzkultur, *Centralbl. Bakt.* I, 103: 73-87, *19 figs.*

—. 1928. Die Protease der pathogenen HautPilze, *Arch. Derm. Syphilis* 154: 493-508.

—. 1934. Zur geographischen Verbreitung der Hauterkrankungen. II. Die Hautpilzerkrankungen in der Rheinprovinz, *Derm. Zeitschr.* 69: 1-23.

Mallinckrodt-Haupt, Asta. v. & C. Carrié. 1934. Die Pilzfluorescenz in vitro, *Arch. Derm. Syphilis* 169: 519-526.

*Malmsten, P. H. 1845. Trichophyton tonsurans, hårskärande Mögel Bidrag till utredande af de sjukdomar som vålla hårets affal. Stockholm, *1 pl.* [tr. by F. C. H. Creplin as: Trichophyton tonsurans der haarscheerende Schimmel. Ein Beitrag zur Auseinandersetzung der Krankheiten welche das Abfallen des Haares bewirken, *Arch. Anat. Physiol. Wiss. Med.* (J. Müller) 1848: 1-19, *1 pl.*, 1848].

Margarot, J. & P. Devèze. 1929. La lumière Wood en dermatologie, *Ann. Derm. Syphiligr.* VI, 10: 581-608.

Marianelli, Amadeo. 1893. Sul Trichophyton tonsurans, Siena, 47 pp.

Markert, H. J. 1921. Experimentelle Untersuchungen über die diagnostische Verwertbarkeit und die Spezifität der Hautimpfungen mit Trichophytinen, *München. Med. Woch.* 68: 1288-1290.

*Marotel, G. 1904. Teigne à Microsporum chez le chat, *Soc. Sci. Vét. Lyon.* 7: 330.

Martenstein, Hans. 1921. Experimentelle Beiträge zur Frage der Überempfindlichkeit des Meerschweinchens nach überstandener Trichophytie, *Arch. Derm. Syphilis* 131: 180-192.

—. 1922. Über die Achorion-Quinckeanum-erkrankung der graviden Meerschweinchen und über das Verhalten ihrer Nachkommen zur Allergie, *Arch. Derm. Syphilis* 140: 329-335.

—. 1923. Weitere experimentelle Untersuchungen über die Allergie des Meerschweinchens nach der Impfung mit Achorion Quinckeanum, *Arch. Derm. Syphilis* 142: 279-304.

Martenstein, Hans & Karl Gerhard Ledermann. 1927. Zur Frage der Doppelinfektion. Wechselseitige Beeinflussung experimenteller Tuberkulose und Trichophytie, *Klin. Woch.* 6: 299-302.

Martinotti, L. 1923. Ricerche sui processi immunitari della cute dei tignosi, *Giorn. Ital. Mal. Ven. Pelle* 64: 132-146, *4 pls.*

Martins, César. 1928. Microsporum lanosum et trois espèces cryptogamiques satellites isolées dans un cas de teigne tondante, *C. R. Soc. Biol.* 98: 1164-1166.

Martins de Castro, Abilio. 1927. Epidermophyton rubrum Cast. Contribuição para o seu estudo clinico, experimantal e parasitologico, *Annaes Fac. Med. São Paulo* 2: 441-477, *Pls. 1-27.*

—. 1928-1929. Tinhas dos animaes domesticos em São Paulo. I. Microsporia: Microsporon felineum C. Fox e T. Blaxall, 1896 e Microsporon canis Bodin-Almy 1897—M. lanosum Sabouraud 1907. *Arch. Inst. Biol. Defesa Agr. Animal.* 1: 202-216, *Pls. 37-43,* 1928. II. Trichophycia: Trichophyton cerebriforme Sabouraud 1893, Trichophyton granulosum Sabouraud 1908. Trichophyton gypseum asteroides Sabouraud 1893. Trichophyton lacticolor Sabouraud 1910. Trichophyton rosaceum Sabouraud 1893, *Ibid.* 2: 163-178, *Pls. 27-39,* 1929.

—. 1931. L'acétate de thallium dans le traitement des teignes, *Ann. Derm. Syphiligr.* VII, 2: 1056-1073.

Masia, Ausonio. 1924. Contributo clinico-sperimentale allo studio delle tricofitidi, *Giorn. Ital. Mal. Ven. Pelle* 65: 1258-1285, *1 pl.*

*Massia, G. 1925. Les teignes tondants dans la région lyonnaise, *Ann. Méd. Praticiens.*

Massia, G. & J. Rousset. 1929. Les microspories et les trichophyties du cuir chevelu chez l'adulte, *Ann. Derm. Syphiligr.* VI, 10: 828-844.

Matras, August. 1931. Über Ekzema mycoticum an Händen und Füssen und seine Pathogenese, *Arch. Derm. Syphilis* 163: 47-58.

—. 1931. Über mykotische Allgemeinexantheme durch das Epidermophyten Kaufmann-Wolf (Generalisierte Epidermophytide), *Arch. Derm. Syphilis* 163: 584-600.

—. 1932. Nägelepidermophytien, hervorgerufen durch den Kaufmann-Wolf-Pilz, *Arch. Derm. Syphilis* 165: 552-564.

—. 1933. Zur Klinik der Epidermophytien, *Wiener Klin. Woch.* 46: 1089-1091.

Matruchot, Louis & Charles Dassonville. 1898. Sur un nouveau Trichophyton produisant l'herpès chez le cheval, *C. R. Acad. Sci.* 127: 279-281.

—. 1898. Recherches expérimentales sur l'herpès du cheval, Trichophyton producteur d'herpès, *C. R. Ass. Franç. Av. Sci. Nantes* 1898: Notes et Mém. 449-455.

—. 1899. Sur la position systématique des Trichophyton et des formes voisines dans la classification des champignons, *C. R. Acad. Sci.* 128: 1411-1413.

—. 1899. Recherches expérimentales sur une dermatomycose des poules et sur son parasite, *Rev. Gén. Bot.* 11: 429-444, *Pls. 18, 19.*

—. 1899. Sur le champignon de l'herpès (Trichophyton) et les formes voisines et sur la classification des ascomycètes, *Bull. Soc. Myc. France* 15: 240-253.

—. 1900. Sur une forme de reproduction d'ordre élevé chez les Trichophytons, *Bull. Soc. Myc. France* 16: 201-208.

—. 1901. Eidamella spinosa, dermatophyte produisant des périthèces, *Bull. Soc. Myc. France* 17: 123-132.

—. 1901. Problème mycologique rélatif aux teignes, *Bull. Soc. Centr. Méd. Vét.* 55: 349-362.

—. 1902. Sur les teignes du chien, *Bull. Soc. Centr. Méd. Vét.* 56: 50-71, *Pl. 1.*

Matta, Alfredo da. 1928. Epidermophytoses e seu tratamento, *Sciencia Medica.* 6: 1-5. [*Brasil Med.* 41: 1394-1396, 1927.]

Matzenauer, Rudolf. 1901. Zur Bacteriologie der Pityriasis versicolor, *Arch. Derm. Syphilis* 56: 163-168, *Pls. 9, 10.*

Mazzoni, Luigi. 1924. 372 casi di tigna tricofitica e favosa del capillizio e della barba curati con la radium terapia, *Giorn. Ital. Mal. Ven. Pelle* 65: 589-591.

—. 1925. Un caso di favo da Achorion gypseum (Bodin), *Arch. Ital. Derm. Sifiligr. Venereol.* 1: 277-280, *2 figs.*

Mazzoni, Luigi & Vincenzo Palumbo. 1920. Sulla depilazione col radium applicata alla cura dei tignosi, *Giorn. Ital. Mal. Ven. Pelle* **61**: 454-458.

Mégnin, Pierre. 1878. Les teignes chez les animaux, *Arch. Gén. Méd.* **141**: 294-304.

—. 1881. Nouvelle maladie parasitaire de la peau chez un coq, *C. R. Soc. Biol.* **33**: 404-406.

—. 1890. Présentation de cultures des champignons de quelques teignes d'animaux domestiques, *Bull. Soc. Centr. Méd. Vét.* **44**: 183-186. [*Annexe Recueil Méd. Vét.*]

Meirowsky, E. 1911. Ueber das wesen der Unnaschen Flaschenbazillen und über den feineren Bau einiger Hautpilze, *Arch. Derm. Syphilis* **108**: 129-140, *Pl. 10.*

Mello, Froilano de. See Froilano de Mello, Indaleneio.

Mense, C. 1918. Zur Zunahme der Hautpilzerkrankungen beim Menschen und Vieh, *Derm. Woch.* **66**: 282, 283.

Mewborn, A. D. 1902. A case of ringworm of the face, and two of the scalp contracted from a Microsporon of the cat with some observations on the identification of the source of infection in ringworm by means of cultures, *New York Med. Jour.* **76**: 843-849.

—. 1903. Report of a case of favus of scrotum co-existing with ringworm of the thigh giving identical Trichophyton-like cultures, *Jour. Cutan. Dis.* **21**: 11-18, *Pls. 2, 3.*

Mguebrow, M. G. 1928. Lésions atypiques de la peau glabre dans le favus, *Ann. Derm. Syphiligr.* VI, **9**: 648-655.

—. 1928. Trichophyties atypiques de la peau glabre dues au Trichophyton violaceum, *Ann. Derm. Syphiligr.* VI, **9**: 742-768, *11* figs.

Mibelli, A. 1925. Tigna del capillizio da Microsporon lanosum, *Giorn. Ital. Derm. Sifilol.* **66**: 663-666.

Mibelli, V. 1895. Sur la pluralité des Trichophytons, *Ann. Derm. Syphiligr.* III, **6**: 733-756.

Michael, Jeffrey C. 1924. The treatment of tineal infections of the hands and feet, *N. Orleans Med. Surg. Jour.* **76**: 320-325.

Michael, Max. 1919. Über die Lebensdauer der Trichophyton-Pilze, *Derm. Woch.* **68**: 209-213.

Miescher, Guido. 1915. Die Trichophytin reaktion im Blutbild, *Derm. Woch.* **61**: 1011-1022.

—. 1921. Ein unter den Bild einer Miliaria rubra verlaufender Fall von ausgedehnter Oidiomykose (Miliaria rubra oidiomycetica), *Derm. Woch.* **73**: 1265-1269.

—. 1925. Untersuchungen über das Vorkommen wachstumsfördernder Wirkungen nach Radiumbestrahlungen an menschenpathogenen Hyphomyceten, *Fortschr. Geb. Röntgenstr.* **33**: 81-84.

—. 1928. Trichophytien und Epidermophytien, *Handbuch der Haut- und Geschlechtskrankheiten* [Jadassohn], **11**: 378-564, *62 figs.*

Milian, G. 1925. Maladies rares de la peau. Favus généralisé, *Rev. Franç. Derm. Vénéréol.* **1**: 124-128, *5 figs.* [no text].

Milian, G. & Panagiotis Photinos. 1928. Trichophytie cutanée généralisée pustuleuse, consécutive à un kerion du cuir chevelu, *Rev. Franç. Derm. Vénéréol.* **4**: 266-272, *3 figs.*

Miller, J. W. 1913. Eczema marginatum, *Urol. Cut. Rev.* **1**: 641-643.

Milochevitch, S. 1931. Sur un cas de trichophytie produit par une espèce nouvelle de Trichophyton, T. Langeroni n. sp., *Ann. Parasitol. Hum. Comp.* **9**: 456-461, *1 pl.*

Minne, Achille J. 1904. Sur un nouveau Trichophyton à cultures violettes, dans nos Flandres, *Ann. Méd. de Gand.* **83**: 49-57, *10 figs.*

*— 1906-1907. *Soc. Belge. Derm.* 7.

*— 1907-1908. *Soc. Belge. Derm.* 8.

—. 1908. Un nouveau Microsporum (Microsporum villosum Minne 1907), *Verhandl. Deutsch. Derm. Ges. Frankfurt. 10 Kongr.* 447-454, *Pls. 11-15.*

*—. 1915. Les teignes en Belgique et plus specialement dans les Flanders, *Lab. Clin. Derm. Univ. Gand.*

*Mitchell, J. A. & G. W. Robertson. 1915. ''Witkop'' or ''Dikwakwadi'' in Bechuanaland natives, *South African Med. Record,* 1915. [Reprinted with additional notes, *Med. Jour. South Africa* **20**: 122-125, *4 figs.,* 1924.]

Mitchell, James Herbert. 1922. Further studies on ringworm of the hands and feet, *Arch. Derm. Syphilol.* 5: 174-197.

—. 1927. Need for research in treatment of epidermophytoses, *Jour. Am. Med. Ass.* 89: 421-423.

Miyake, Isam. 1925. Über die Vitalfärbung der Trichophyticpilze, *Jap. Jour. Derm. Urol.* 25: 343-361, *Pls. 14, 15.*

Möglich, Alfred. 1923. Über Pilzebefunde an Lanugohaaren bei oberflächlichen Trichophytie, *Diss. Friedrich-Wilhelms Univ. Breslau.*, 4 pp.

Montgomery, Douglass W. & George D. Culver. 1914. Eczema marginatum of the toes, *Jour. Am. Med. Ass.* 62: 1076-1078.

Montlaur & Dumet. 1922. Épidermomycose due à Trichophyton rubrum vel purpureum de Crat-Bang, *Congr. Dermatologistes Syphiligraphes Langue Franç. Paris* 1: 38-40.

Montpellier, Jean. 1918. Les Trichophyties à Alger, *Bull. Soc. Path. Exot.* 11: 350, 351.

—. 1924. Effloresences cutanées chez les vieux faviques. La question des favides, *Bruxelles Méd.* 5: 48-51.

Montpellier, Jean & Adrien Lacroix. 1919. Un cas de teigne tondante du au Microsporum lanosum rencontré à Alger, *Bull. Soc. Franç. Derm. Syphiligr.* 26: 202-205, *1 fig.*

Montpellier, Jean & P. J. Matamoros. 1927. Trichophytie pubo-crurale due à Trichophyton persicolor, *Bull. Soc. Franç. Derm. Syphiligr.* 34: 128-130, *1 fig.*

*Moriyama, Giroku. 1927. Studien über sogenannter La-li-ton, eine infektiöse Erkrankung des Kopfes in China, *Jap. Jour. Derm. Urol.* 27: 665-685.

Mucci, A. 1925. Epidermofizie palmari a tipo disidritico secco, *Giorn. Ital. Derm. Sifilol.* 66: 982-987.

Müller, Ernst Friedrich. 1918. Zur Kenntnis der Immunität für Hautpilzerkrankungen, *Derm. Woch.* 67: 825-829.

Müller, J. & A. Retzius. 1842. Über parasitische Bildungen. II. Ueber pilzartige Parasiten in den Lungen und Lufthöhlen der Vögel, *Arch. Anat. Physiol. Wiss. Med.* 1842: 198-212.

Muende, I. 1933. Allergic skin affections related to fungus infection, *Post-grad. Med. Jour.* N. S. 9: 197-205.

Münsterer, H. O. 1931. Beitrag zur Kenntnis der Dermatomykosen Südbayerns und zur Kasuistik der Sporotrichose, *Arch. Derm. Syphilis* 163: 97-113.

Muijs, D. 1916. Trichophyton rosaceum, *Nederl. Tijdschr. Geneesk.* 60: 1985-1992, *2 pls.*

—. 1917. Favus van het behaarde hoofd niet veroorzakt door het Achorion van Schoenlein, *Nederl. Tijdschr. Geneesk.* 61: 449-455.

—. 1918. Microsporum lanuginosum, *Nederl. Tijdschr. Geneesk.* 62: 1: 1497-1509.

—. 1921. Trichophyton marginatum, *Nederl. Tijdschr. Geneesk.* 65: 2205-2207.

Mulzer, P. & R. Nothhaas, 1926. Über einen Fall von ausgedehnter Mikrosporie der Haut bei einem syphilitischen Affen, *Wien. Med. Woch.* 76: 912-914, *2 figs.*

Munro, William J. 1907. Ringworm and its treatment, *Australasian Med. Gaz.* 26: 509, 510.

Muskatblit, Emanuel. 1933. Ringworm of the toes in students and dispensary patients, *New York State Jour. Med.* 33: 632-637, *7 figs.*

—. 1933. Observations on Epidermophyton rubrum or Trichophyton purpureum, *Mycologia* 25: 109-116, *3 figs.*

Muskatblit, Emanuel & W. Director. 1933. The trichophytin test: report of three hundred and fifty cases, *Arch. Derm. Syphilol.* 27: 739-744.

*Myahara, A. 1923. Tinea imbricata in Formosa, *Jap. Jour. Derm. Urol.* 23: 462.

Nagel, Heinrich. 1914. Über das Auftreten der Mikrosporie in Heidelberg, *Inaug. Diss. Univ. Heidelberg,* 53 pp.

Naegeli. 1921. Scarlatiniformes Spättrichophytid nach Angina lacunaris, mit in Abheilung begriffenem Primärherd am Handgelenk, *Arch. Derm. Syphilis* 134: 323-327, *Pl. 20.*

Nakamura, Toshiro. 1931. Über eine bisher nicht beschriebene Art von Microsporon in Japan, *Jap. Jour. Derm. Urol.* 31: 1462-1472, *16 figs.* [152].

*—. 1932. Über die Nageltrichophytie und eine neuentdeckte Pilzvarietät, *Jap. Jour. Derm. Urol.* 32: 515-527, *10 figs.* [65, 66].

Nannfeldt, J. A. 1932. Studien über die Morphologie und Systematik der nicht-lichenisierten Inoperculaten Discomyceten, *Nova Acta R. Soc. Sci. Upsala.* IV, 8: 2: 1-368, *Pls. 1-20.*

Nannizzi, Arturo. 1926. Ricerche sui rapporti morfologici e biologici tra Gymnoascaseae e Dermatomiceti, *Ann. Myc.* 24: 85-129, *6 pls.*, *12 figs.*

—. 1926. Su la supposta forma oospora (Actinomyces) di Bodin del ''Microsporum equinum,'' *Arch. Ital. Derm. Sif. Ven.* 1: 478-484.

—. 1927. Ricerche sull'origine saprofitica dei funghi delle tigne Il Gymnoascus gypseum sp. n., forma ascofora del Sabouraudites (Achorion) gypseum (Bodin) Ota et Langeron, *Atti R. Accad. Fisiocrit. Siena* X, 2: 89-97, *4 figs.*

—. 1930. Sulla posizione sistematica dei Dermatomiceti, *Atti Ist. Bot. R. Univ. Pavia.* IV, 2: 103-110.

Nathan, E. 1920. Zur Kenntnis der Immunitätsvorgänge bei der Trichophytie der Menschen, *Derm. Woch.* 71: 439-448.

*Nauck, Ernst G. 1932. Die Dermatomykosen in den Tropen, *Handbuch der Haut- und Geschlechtskrankheiten* [Jadassohn?] 122 pp., *125 figs.*

*Navarro-Martin, A. 1932. Tratamiento de las tricoficias profundas por inyecciones intravenosas de tripaflavina, *Actas Dermo-Sifiliograficas* 25.

Née, Paul. 1906. État actuel de la question de favus humain, *Arch. de Parasitol.* 11: 268-338. [Thèse de Paris, 1906.]

Neebe & P. G. Unna. 1893. Die bisher bekannten neun Favusarten, *Monatsh. Prakt. Derm.* 16: 17-31, 57-72.

Negroni, Pablo. 1929. Un nouveau Trichophyton endothrix, Trichophyton areolatum n. sp., *Ann. Parasitol. Hum. Comp.* 7: 438-443.

—. 1930. Sobre el posible error diagnóstico de Trichophyton crateriforme como agente de tricoficia de la barba, *Congreso Intern. Biol. Montevideo* Oct. 11, 1930.

—. 1931. Datos estadísticos de 157 casos de micosis humanas estudiados en la ciudad de Buenos Aires. Algunas consideraciones de órden médico, *Folia Biol.* 1931: 15-18. [Published in greater detail in *Revista Soc. Argentina de Biologia* 7: 275-281, 1931.]

—. 1931. Statistique de 157 cas de mycose etudiés à Buenos Aires, *C. R. Soc. Biol.* 108: 137, 138.

—. 1932. Constatation du Trichophyton areolatum Negroni en Argentine, *C. R. Soc. Biol.* 110: 139, 140.

Neidhart, Leopold. 1924. Beitrag zur Strahlenempfindlichkeit pathogener Hautpilze (Sporotrichum Beurmanni und Trichophyton gypseum), *Diss. Med. Fak. Zürich.* 29 pp.

Neisser, A. 1902. Plato's Versuche über die Herstellung und Verwendung von Trichophytin nach seinem Ableben mitgeteilt, *Arch. Derm. Syphilis* 60: 63-76.

*Nekatchalov, V. J. 1931. Contribution à l'étude des trichophytides focales survenant aux régions traumatisées, *Sovietsky Vestnik Derm.* 9: 10-21.

Nencioni, Mario. 1924. Onicomicosi da Scopulariopsis brevicaulis (var. hominis) sin. Penicillium brevicaule (var. hominis), *Giorn. Ital. Mal. Ven. Pelle* 65: 972-977, *2 pls.*

Neuber, Eduard. 1925. Die in Ungarn vorkommenden pathogenen Pilze auf der Haut und ihren anhängen. Eine neue Trichophytieart, Trichophyton fuscum sulcatum, *Derm. Woch.* 80: 861-872.

—. 1930. Beiträge zur der Pathologie und Therapie der humanen Mikrosporie, *Derm. Woch.* 90: 366-369.

Nicolas, J. & L. Lacomme. 1906. Dermatomyces des régions glabres causées chez l'homme par le Microsporon canis, *Ann. Derm. Syphiligr.* IV, 7: 321-326, *Pls. 2, 3.*

Nicolau, S. 1909. Étude sur la trichophytie du cuir chevelu en Roumanie (Trichophyton violaceum), *Ann. Derm. Syphiligr.* IV, 10: 609-638, *16 figs.*

—. 1913. Contribution à l'étude du soi-disant ''Eczema marginatum'' de Hebra. (Epidermophyton inguinale de Sabouraud, Epidermophyton plicarum), *Ann. Derm. Syphiligr.* V, 4: 65-87, *Figs. 1-12.*

Nieuwenhuis, A. W. 1898. Tinea imbricata (W. Manson), *Arch. Derm. Syphilis* 46: 163-176.

—. 1907. Lokalisation und Symmetrie der parasitären Hautkrankheiten im indischen Archipel, *Verh. K. Akad. Wetensch. Amsterdam. Tweede Sect.* 10: 4: 1-16, *Pls. 1-8.*

Niño, Flavio L. 1932. Tricopatía microspórica ectothrix del cuero cabelludo, *Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán* 7: 384-400, *5 pls., 5 figs.*

Niño, Flavio L. & Prudencio Santillán. 1932. Querion del cuero cabelludo en un niño de la ciudad de Tucumán, *Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán* 7: 401-411.

Niño, Flavio L. & Jorge Harvey Silva. 1930. Favus recidivante del cuero cabelludo (Estudio micológico.), *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 5: 192-212, *Pl. 1, 6 figs.* [5ta *Reunión Soc. Argentina Patol. Regional del Norte, Jujuy,* 1929].

Nobl, G. 1914. Generalisierte animale Mikrosporie beim Menschen, *Derm. Woch.* 58: 337-343, *Pl. 6, Figs. 4, 5.*

Novgaard, V. A. 1901. Fusarium equinum, n. sp., *Sci. NS* 14: 898, 899.

Noyes, A. W. Finch. 1891. The artificial cultivation of Trichophyton, fungus (ringworm) of the skin and hair, *Australian Med. Jour.* N. S. 13: 473-479, *1 pl.*

Ochoterena, Isaac. 1923. La nueva clasificación de las dermatofitas, *Rev. Mex. Biol.* 4: 67, 68.

—. 1924. Une nouvelle espèce de champignon producteur de teignes Sabouraudites (Aleurocloster) Urenae Ochoterena, *Rev. Mex. Biol.* 4: 94-100, *7 figs.*

Ogata, S. 1929. Über die Trichophytie in der Umgegend von Chiba mit besonderer Berücksichtigung über ihre Erreger, *Jap. Jour. Derm. Urol.* 29: 1183-1232, *Pl. 41, 25 figs., 1 map.* [German summary 80-84.]

—. 1930. Ueber den Pollaccischen Nährboden, *Jap. Jour. Derm. Urol.* 30: 442-448. [German summary 52.]

Ormsby, Oliver S. & James Herbert Mitchell. 1916. Ringworm of the hands and feet, *Jour. Am. Med. Ass.* 67: 711-717, *11 figs.*

Oro, Augusto. 1926. Sul granuloma tricofitico di Majocchi, *Arch. Ital. Derm. Sifiligr. Venereol.* 1: 424-463, *10 figs.*

Osborne, Earl D. & Blanche S. Hitchcock. 1931. The prophylaxis of ringworm of the feet, *Jour. Am. Med. Ass.* 97: 453-455.

Ota, Masao. 1918-1920. Über das Wesen der Dysidrosis, *Jap. Zeitschr. Derm. Urol.* 18: 1-23, *Pls. 1, 2* [2-5], *II, *Jap. Zeitschr. Derm. Urol.* 20: 477.

*—. 1921. Recherches sur les trichophyties en Mandchourie, *Jap. Zeitschr. Derm. Urol.* 21: 201, 330.

—. 1922. Brief notes on Trichophyton rubrum Castellani, 1909 (Trichophyton purpureum Bang 1910), and Trichophyton violaceum var decalvans Castellani 1913 with remarks on ''Eczema marginatum'' (''Tinea cruris seu inguinalis'') in Japan and ''la ti tou'' or ''parasitic folliculitis'' (''Tinea decalvans'' pro parte) of Southern China, *Brit. Jour. Derm. Syphilis* 34: 120-124.

—. 1922. Sur deux espèces nouvelles de dermatophytes en Mandchourie. Microsporum ferrugineum et Trichophyton pedis n. sp., *Bull. Soc. Path. Exot.* 15: 588-596.

—. 1922. Contribution to the study of Trichophyton purpureum Bang, Trichophyton interdigitale Priestley and Trichophyton B. Hodges. Also on Trichophyton ''*a*'' and Trichophyton ''β'' of the author, *Arch. Derm. Syphilol.* 5: 693-713.

—. 1923. Beitrag zur Studie des Trichophyton purpureum Bang, Tr. interdigitale Priestley und Tr. ''β'' Hodges, *Jap. Jour. Derm. Urol.* 23: [18 pp. in Japanese with 2 pp. German summary].

—. 1925. Sur les mycoses au Japon et en Chine et sur leurs champignons agents, *Trans. 6th Congr. Far East. Ass. Trop. Med., Tokyo, Japan* [9 pp.].

—. 1931. Epidermophyton-Epidermidophyton, *Ann. Parasitol. Hum. Comp.* 9: 277-281.

Ota, Masao & H. Gaillard. 1926. Sur une teigne trichophytique d'un bovidé du Cameroun produite par une espèce nouvelle de Grubyella, G. camerounensis n. sp., *Ann. Parasitol. Hum. Comp.* 4: 14-21, *3 figs.*

Ota, Masao & Y. Kawasaki. 1922. Über Eczema marginatum in Japan, mit besonderer Berücksichtigung der Ätiologie, *Jap. Zeitschr. Derm. Urol.* 22: 758-780, *Pls. 15-17* [64, 65].

Ota, Masao & Shuji Kawatsuré. 1931. Inoculabilité au cobaye et immunologie des champignons parasites du genre Endodermophyton Castellani, *Ann. Parasitol. Hum. Comp.* 9: 144-161, *Pls. 2, 3.*

Ota, Masao & Maurice Langeron. 1923. Nouvelle classification des dermatophytes, *Ann. Parasitol. Hum. Comp.* 1: 305-336.

*Ota, Masao & Ping Ting Huang. 1933. Trichophytie in Meereskustengegenden Südchinas, *Jap. Jour. Derm. Urol.* 34: 71.

Papegaaij, Justus. 1924. Over pathogene huidschimmels in Amsterdam (vorkomend bij den mensch), *Acad. Proefschrift Amsterdam,* 119 pp., *3 pls.* [1925. Over pathogene huidschimmels in Amsterdam (vorkomend bij den Mensch), *Nederl. Tijdschr. Geneesk.* 69: 879-890, *Pl. 1.*]

—. 1926. Trichophyton eriotrephon n. sp., *Acta. Dermato-venereol.* 7: 1-6, *Pl. 1.*

Pappagallo, Stefano. 1910. Epidermofizia inguinale (eczema marginato di Hebra), *Giorn. Ital. Mal. Ven. Pelle* 51: 749-757.

Pardo Castello, V. 1933. Dermatomicosis cubanas. Algunas consideraciones sobre las afecciones cutaneas producidas por los dermatofitos in Cuba, *Vida Nueva* 32: 13-20 [II, 7].

Pardo Castello, V., J. J. Mestre & Enrique Rio. 1929. Tinea of the scalp, treatment with thallium salts, *Arch. Derm. Syphilol.* 19: 409-422.

Parish, H. J. & S. Craddock. 1931. A ringworm epizootic in mice, *Brit. Jour. Exp. Path.* 12: 209-212.

Parreiras Horta. 1919. A Sarna, *Tribuna Med. Rio de Janeiro* 25: 122-125.

—. 1924. Uma nova tinha microsporica braziliera, Microsporon Ramos, n. sp. (Nota previa), *Brasil Med.* 38: 59, 60.

Pasini, A. 1911. Tigna microsporica da Microsporon iris, *Giorn. Ital. Mal. Ven. Pelle* 52: 613-636, *Pls. 1-5bis.*

—. 1912. Due casi di tigna da Microsporon equinum, *Giorn. Ital. Mal. Ven. Pelle* 53: 25-32, *1 pl.*

—. 1920. La tigna microsporica nelle provincie di Milano e di Como, *Giorn. Ital. Mal. Ven. Pelle* 61: 376-380.

—. 1920. Tigna microsporica al capillizio di una adulta, *Giorn. Ital. Mal. Ven. Pelle* 61: 381-384.

—. 1923. Favide. Achoriide, *Giorn. Ital. Mal. Ven. Pelle* 64: 158-160.

Paul, C. Norman. 1916. The occurrence of ringworm of the scalp in Sidney, *Med. Jour. Australia* 3: 1:237.

—. 1917. A ringworm epidemic presenting a new type of fungus, *Med. Jour. Australia* 4: 2:496, 497, *2 figs.*

Paulus, Fritz. 1906. Beitrag zur Anatomie des Favus-Scutulum, *Derm. Zeitschr.* 13: 233-250.

—. 1906. Beitrag zur Klinik des Favus, *Derm. Zeitschr.* 13: 89-106.

Pautrier, L. M. & B. Rietmann. 1922. Epidémie de cent cas d'épidermophytie généralisée due au "Trichophyton granulosum," *Bull. Soc. Franç. Derm. Syphiligr.* 29: Réunion Derm. Strasbourg 98-108, *6 figs.*

—. 1924. Trichophytie cutanée à forme d'épidermophytie dues au Trichophyton granulosum, et provoquée par une infection de laboratoire, *Bull. Soc. Franç. Derm. Syphiligr.* 31: Réunion Derm. Strasbourg 29-31.

Payenneville, J. & Marie. 1928. Un cas de favus (Achorion de Schoenlein) de la paupière et du cuir chevelu chez un nourrison de 16 jours, *Bull. Soc. Franç. Derm. Syphiligr.* 35: 567-569, *2 figs.*

Peck, Samuel M. 1929. Epidermophytide in der Form postscarlatinöser Schüppungen an den Händen, *Klin. Woch.* 8: 1357, 1358.

—. 1930. Epidermophytosis of the feet and epidermophytids of the hands. Clinical, histological, cultural, and experimental studies, *Arch. Derm. Syphilol.* 22: 40-76, *1 pl., 11 figs.*

Peck, Samuel M. & Gustav Salomon. 1931. Eczema due to fungi. Report of a case in an eighteen-month-old baby, *Arch. Derm. Syphilol.* 24: 554-556.

Pecori, Giuseppe. 1913. I tricofiti della provincia di Roma, *Giorn. Ital. Mal. Ven. Pelle* 54: 354-380.

Pécus, M. 1909. Une épidémie de trichophytie équine (800 cas) [Analyse mycologique par M. le Dr. Sabouraud], *Rev. Gén. Méd. Vét.* 13: 561-586.

*Pedersen, Brun. 1916. Über die sogenannten sekundäre lichenoide Trichophytie. Hospitalstidende. [*Derm. Woch.* 65: 744.]

*—. 1916. Ausgebreitetes Eczema marginatum nach Behandlung mit feuchten Verbänden, *Ugeskrift Laeger.* :27 [*Derm. Woch.* 65: 725.].

—. 1917. Ein Beitrag in das Studium der Pathogenese der sekundären Trichophytide, *Derm. Zeitschr.* 24: 731-736.

Pelagatti, Mario. 1896. I tricofiti della provincia di Parma, *Giorn. Ital. Mal. Ven. Pelle* 37: 724-746.

—. 1910. Di una varietà di Microsporum non ancora descritta, *Giorn. Ital. Mal. Ven. Pelle* 51: 254, 255.

Pelevine, A. & N. Tchernogouboff. 1927. Trichophytie chronique de la peau et des phanères chez tous les membres d'une même famille. Trichophytie propagée aux muqueses aux ganglions lymphatiques et aux os, *Ann. Derm. Syphiligr.* VI, 8: 403-419 [followed by observations by R. Sabouraud, 420-424].

—. 1928. Nouvelles données dans la doctrine de la trichophytie, *Acta Dermato-Venereol.* 8: 397-446, *2 pls., 27 figs.*

Peli, Gino. 1933. Contributo alla conoscenza del dosaggio biologico-sperimentale dell'acetato di tallio a scopo alopecizzante e del salicilato di tallio non ancora conosciuto, *Giorn. Ital. Derm. Sifilol.* 74: 1613-1622, *1 pl.*

Peña Chavarría, Antonio & Janet H. Clark. 1924. The reaction of pathogenic fungi to ultraviolet light and the rôle played by pigment in this reaction, *Am. Jour. Hyg.* 4: 639-649, *6 figs.*

Périn, Lucien. 1930. L'eczema marginé de Hebra chez le nourisson, *Rev. Franç. Derm. Vénéréol.* 6: 73-81.

Pernet, George. 1925. Ringworm of the scalp. Report of a case in an adult, *Arch. Derm. Syphilol.* 12: 267.

Petges, G. & P. Joulia. 1923. Les variétés de teignes du cuir chevelu observées à Bordeaux de 1919 à 1922, *Ann. Derm. Syphiligr.* VI, 4: 9.

Pezzi, Giuseppe. 1931. Contributo allo studio del piede di Hongkong, *Ann. Med. Nav. Colon.* 2: 713-722, *2 pls.*

Phelps, J. P. 1925. Mycosis of the hands and feet, crutch itch, bullous dermatitis of the feet, etc., *U. S. Naval Bull.* 22: 79-82.

Photinos, Georges Th. 1906. Contribution à l'étude et au traitement des affections cutanées et ganglionaires de la région inguino-crurale, Paris, A. Maloine, 141 pp.

Photinos, Panagiotis. 1928. Dermatomycose symétrique palmaire datant de onze ans due au Trichophyton faviforme ochraceum, *Bull. Soc. Franç. Derm. Syphiligr.* 35: 118-120.

Pick, Filipp Joseph. 1869. Das Eczema marginatum. Eine Studie über Art und Wesen dieser Krankheit, *Arch. Derm. Syphilis* 1: 61-88.

Pijper, Adrianus. 1918. Tinea imbricata in South Africa, *Jour. Trop. Med. Hyg.* 21: 45-47.

Pini, Giovanni & Leonardo Martinotti. 1910. Trichophytia capitis à Trichophyton plicatile, *Giorn. Ital. Mal. Ven. Pelle* 51: 895-901, *1 pl.*

Pinoy, E. 1912. Sur une teigne cutanée du singe, *C. R. Soc. Biol.* **72**: 59.

—. 1912. Epidermophyton du singe, *Bull. Soc. Path. Exot.* **5**: 60-63, *Pls. 3, 4.*

Plato, J. & H. Guth. 1901. Über den Nachweis feinerer Wachstumsvorgänge in Trichophyton und anderen Fadenpilzen mittels Neutralrot. Experimentelle Untersuchungen, *Zeitschr. Hyg. Infektionskr.* **38**: 319-331, *Pl. 6.*

Plaut, H. C. 1909. Dermatomykosen, *Handbuch der Hautkrankheiten* [Mraček] 4: 2: 1-177.

—. 1914. Geographische Verbreitung der Hautpilze und ihre Bedeutung für Hamburger Gebiet, *Derm. Woch.* **58**: Ergänzungsheft: 70-76.

*—. 1919. Microsporon pertenue, *Hamburger Derm. Ges.* **11**.

Podwyssotzkaja, O. N. & S. K. Rosenthal. 1933. Über Trichophytose (Beitrag zur Kenntnis der chronischen Trichophytie der Erwachsenen), *Arch. Derm. Syphilis* **168**: 572-585, *4 figs.*

*Pollacci, Gino. 1922. Miceti del corpo umano e degli animali. II. Contributo allo studio delle dermatomicosi, *Riv. Biol.* **4**.

—. 1925. Nuove osservazioni sul ciclo di sviluppo dei generi Trichophyton, Achorion, Microsporon e loro rapposti con forme saprofitiche, *Bull. Soc. Bot. Ital.* **1925**: 127-130. [*also cited *Giorn. Ital. Derm. Sifilol.* **66**: 572, 1925.]

—. 1932. Sulla posizione sistematica dei miceti delle tigne (Rivendicazioni), *Atti Ist. Bot. R. Univ. Pavia* IV, 3: 15-18.

*Porcelli, R. 1922. Achorion gypseum Bodin per la conoscenza degli Achorion di origine animale. Studio clinico, micologico e sperimentale. Meucci, Livorno. 1922.

Porosz, Moriz. 1923. Eine für ansteckend gehaltene Hautabschuppung der Hände (Dyshidrosis sicca lamellosa), *Derm. Woch.* **76**: 216, 217.

Priestley, Henry. 1914. Microsporon scorteum (n. sp.) from a case of ringworm in man, *Ann. Trop. Med. Parasit.* **8**: 113-118, *Pl. 7.*

—. 1917. Ringworm and allied parasitic skin diseases in Australia, *Med. Jour. Australia* [4]:2: 471-475, *13 figs.*

Procházka, Karel. 1926. Eine durch Trichophyton violaceum hevorgerufene Hausepidemie, *Acta Dermato-Venereol.* **7**: 47-62, *Pl. 2.*

—. 1927. Un raro caso di tricofizia cutanea superficiale atrofizzante, *Giorn. Ital. Derm. Sifilol.* **68**: 1433-1439, *Pl. 1.*

Prytek. 1912. Zur Kenntnis der Immunität nach Trichophytie Infektion, *Arch. Derm. Syphilis* **113**: 121-142.

Pulvermacher, Leopold. 1919. Zur Klinik und Pathogenese der Trichophytide, *Derm. Zeitschr.* **27**: 11-31.

Puntoni, Vittorio & E. J. Pampana. 1932. A copper-colored variety of carate caused by Trichophyton Megnini (Tr. rosaceum), *Jour. Trop. Med. Hyg.* **35**: 154-156.

Quero, Roberto. 1931. Accidentes de la tricofitinoterapía, *Bol. Soc. Cubana Derm. Sifilogr.* **2**: 91-99.

Quincke, H. 1886. Über Favuspilze, *Arch. Exp. Path. Pharm.* **22**: 62-76, *3 pls.*

—. 1887. Über Favus, *Monatsh. Prakt. Derm.* **6**: 981-987.

—. 1895. Zur Favusfrage, *Arch. Derm. Syphilis* **31**: 65-69.

Rabello, Eduardo & Olympio da Fonseca Filho. 1926. Dermatomycose vegetante disseminada, *Brasil Med.* **40**: 2: 141. [Acad. Nac. Med.]

Rabut, Robert & Dumet. 1923. Un cas de ''favus gypseum'' de Bodin, *Bull. Soc. Franç. Derm. Syphiligr.* **30**: 391-393.

—. 1926. Trichophytie erythemato-squameuse de la barbe, *Bull. Soc. Franç. Derm. Syphiligr.* **33**: 168-170.

Radaeli, Alessandro. 1924. Sopra alcuni casi di microsporia da M. felineum (C. Fox e F. Blaxall, 1896), *Giorn. Ital. Mal. Ven. Pelle* **65**: 1670-1685, *1 pl.*

—. 1925. Contributo allo studio dei fenomeni immunitari nelle tigne, *Giorn. Ital. Derm. Sifilol.* **66**: 612-628.

Rajka, Edmund. 1923. Skarlatiniformes Trichophytid bei dysidrosisähnlicher Trichophytie, *Derm. Woch.* **76**: 574-577.

—. 1923. Zur Ätiologie der Dyshidrose, *Arch. Derm. Syphilis* 143: 204-210.

—. 1924. Eine äusserst oberflächliche Form der Trichophytie, *Derm. Woch.* 79: 1252-1254.

Rasch, C. 1922. Skin affections caused by Achorion gypseum (Bodin), *Brit. Jour. Derm. Syphilis* 34: 1-5, *1 fig.*

—. 1923. Eczema marginatum Hebra and other mycoses resembling eczema, *Acta Dermato-Venereol.* 3: 312-344, *16 figs.*

Ravaut, Paul, Basch & H. Rabeau. 1928. Épidémic de trichophytie cutanée determinée par le Trichophyton niveum radians (Sabouraud). Polymorphisme des lésions, réactions, humorales, *Presse Méd.* 36: 609-612, *16 figs.*

—. 1928. Étude clinique et biologique d'une épidémie de trichophytie cutanée due au Trichophyton niveum radians, *Ann. Derm. Syphiligr.* VI, 9: 923-970.

Ravaut, Paul & H. Rabeau. 1921. Sur une forme spéciale de trichophytie unguiale, *Ann. Derm. Syphiligr.* VI, 2: 363-365.

Ray, Hartzell Harrison. 1929. The fluorescent properties of ringworm of the scalp as an aid in diagnosis, *Am. Jour. Dis. Children* 38: 339-341.

Raynaud, L. & H. Verité. 1908. Les teignes dans les écoles et la population infantile d'Alger, *Jour. Mal. Cut. Syph.* VI, 19: 81-93.

Reiss, Friedrich. 1923. Eine eigenartige Nagelmykose in China. (Onycholysis trichophytica), *Derm. Woch.* 77: 891, 892.

Remak, Robert. 1840. Zur Kenntnis von der pflanzlichen Natur der Porrigo lupinosa, *Med. Zeitung* 9: 73, 74.

*—. 1845. Diagnostische und pathologische Untersuchungen. 7: Muscardine und Favus (Porrigo lupinosa). 193-215, Berlin.

Ress, Hermann Franz Josef. 1920. Beitrag zur Frage der Trichophytide. (Ein Fall eines wahrscheinlich nicht auf haematogenem Wege verbreiteten Trichophytids.) *Inaug. Diss. Marburg.* 24 pp.

Reynier, Edmond de. 1916. Une epidémie de teigne à petites spores chez des écoliers, *Rev. Méd. Suisse Romande* 36: 625-635.

Riehl, Gustav. 1912. Über mikrosporie in Wien, *Wien. Med. Woch.* 62: 1477-1483, *1 fig.*

*Rietmann, Br. 1927. Sobre as tinhas na cidade do Salvador, Brasil. *Tesis.*

Ritter, H. 1926. Bemerkungen zu aktuellen Fragen der Dermatomykologie. Zur Einführung, *Arch. Derm. Syphilis* 156: 158-160. I. Mitteilung über kulturellen Nachweiss erfahrungsgemäss pathogener Pilze auf klinisch gesunder Haut und über seine Beurteilung von C. L. Karrenberg, *Ibid.* 156: 160-172. 1926.

Rivalier, E. 1922. Un cas de teigne trichophytique chez l'adulte, *Bull. Soc. Franç. Derm. Syphiligr.* 29: 128-130.

—. 1929. Recherches experimentales sur l'allergie et l'immunité trichophytique, *Ann. Derm. Syphiligr.* VI, 10: 619-640.

—. 1930. Sur une épidermophytie de la région inguinocrurale due à Trichophyton gypseum, *Rev. Franç. Derm. Vén.* 6: 532-539, *1 fig.*

Rivalier, E. & S. Seydel. 1932. Nouveau procédé de culture sur lames gélosées appliqué à l'étude microscopique des champignous des teignes, *Ann. Parasitol. Hum. Comp.* 10: 444-452.

Roberts, Leslie. 1894. The physiology of the Trichophytons, *Jour. Path. Bact.* 3: 300-309.

—. 1899. Experimental note on the ferments of the ringworm fungi, *Brit. Med. Jour.* 1: 13, 14.

—. 1902. Note on a specimen of tinea microsporon of the cat, *Brit. Jour. Derm. Syphilis* 14: 327-332, *1 pl.*

Rodriguez, J. A. 1908. **Rev. Méd. Uruguay* [rev. as: Contribution à l'étude de l'anatomie pathologique et de la pathogénie de la trichophytie animale, *Semaine Méd.* 28: 81].

Ronchese, Francesco. 1922. La terapia di affezioni volgari e parassitarie della barba con iniezioni endovenose di soluzione jodoiodurata, *Giorn. Ital. Mal. Ven. Pelle* 63: 918-925.

Roquette, Miramond de la. 1921. Traitement des soldats indigènes algeriens atteints de favus, *Jour. Radiol. et d'Électrol.* 5: 501.

Rosenbach, Anton Julius Friedrich. 1894. [Often cited as F. J. Rosenbach.] Über die tieferen eiternden Schimmelerkrankungen der Haut. J. F. Bergmann: Wiesbaden 43 pp., *6 pls.* [*Brit. Jour. Derm. Syphilis* 7: 44-48, 1895.]

Rosenbaum, Ernst. 1924. Virulenzunterschiede bei Trichophytonstämmen, *Derm. Woch.* 78: 99, 100.

Rosenstein, Walter. 1923. Experimentelle Untersuchungen zur Prophylaxe der Dermatomykosen, *Centralbl. Bakt.* I, 90: 331-336.

Roxburgh, A. C. 1927. The detection of ringworm hairs on the scalp by their fluorescence under ultraviolet light, *Brit. Jour. Derm.* 39: 351, 352.

Ruete, A. E. & Ursula Scholz. 1934. Über Epidermophytide und Epidermophytin, *Derm. Zeitschr.* 68: 241-245.

Ruggles, E. Wood. 1929. Some phases of epidermophytosis, *New York State Jour. Med.* 29: 740-743.

Rusin, André. 1933. Teignes humaines de l'Afrique, *Thèse Fac. Méd. Univ. Paris* 497: 1-60.

Russ, Charles. 1923. A skin eruption due to a mould, *Lancet* 204: 77, 78, *2 figs.*

Sabouraud, Raimond. 1892-1893. Contribution à l'étude de la trichophytie humaine. I. Étude clinique, microsporique et bactériologique sur la pluralité des Trichophytons de l'homme, *Ann. Derm. Syphiligr.* III, 3: 1061-1087, *2 pls.*, 1892. II. Les Trichophyties à grosses spores, *Ibid.* III, 4: 116-149, 1893. III. Étude synthétique de la trichophytie à grosses spores. Les Trichophytons animaux sur l'homme: trichophyties piliares de la barbe, *Ibid.* III, 4: 814-835, *2 pls.*, 1893.

—. 1893. Étude des trichophyties à dermite profond spécialement de la folliculite agminée de l'homme et de son origine animale, *Ann. Inst. Pasteur* 7: 497-528, *Pls. 6, 7.*

—. 1893. Note sur l'hypothèse d'une existence saprophyte des Trichophytons, *Ann. Derm. Syphiligr.* III, 4: 561-566.

—. 1894. Les trichophyties humaines. Paris, Rueff et Cie. x, 231 pp. [for atlas see La teigne trichophytique et la teigne spéciale de Grüby, Paris, Rueff et Cie. 62 pp., *175 figs.*, 1894.]

—. 1907. Nouvelles recherches sur les Microsporums, *Ann. Derm. Syphiligr.* IV, 8: 161-183, 225-245, 326-336, 369-386, *Pls. 1, 2.*

—. 1907. Sur l'eczéma marginatum de Hebra, trichophytie inguinale et son parasite (Trichophyton inguinale Sabouraud), *Arch. Méd. Exp. Anat. Path.* 19: 565-586, 737-766, *Pls. 17, 18, 16 figs.*

—. 1908. Sur le pléomorphisme des cultures des dermatophytes et le moyen de l'empêcher, *Arch. de Parasitol.* 12: 33-39, *5 figs.*

—. 1908. Le Trichophyton à culture acuminée et le Trichophyton à culture crateriforme (Tr. Acuminatum, Tr. crateriforme Sabouraud), *Arch. de Parasitol.* 12: 33-98, *46 figs.*

—. 1908. Identification du Microsporum lanosum (Sabouraud 1907), au Microsporum caninum (Bodin et Almy 1897), *Ann. Derm. Syphiligr.* IV, 9: 153-156.

—. 1908. Les trichophytons faviformes, *Ann. Derm. Syphiligr.* IV, 9: 609-635, *Pl. 2.*

—. 1910. Maladies du cuir chevelu. III. Les maladies cryptogamiques. Les Teignes. Masson et Cie. Paris, 855 pp., *28 pls., 433 figs.*

—. 1910. Sur l'existence fréquente d'un soi-disant eczéma des doigts et des orteils dû à l'Épidermophyton inguinale, *Ann. Derm. Syphiligr.* V, 1: 289-296, *3 figs.*

—. 1912. Sur l'eczéma marginatum de Hebra et sa très fréquente localisation aux pieds, *Arch. Derm. Syphilis* 113: 923-934, *Pls. 36-40.*

—. 1919. The contagiousness of favus in man, *Lancet* 197: 581, 582.

—. 1921. Certain unclassified epidermophytes of the body and of the hands, *Urol. Cut. Rev.* 25: 443-445.

—. 1924. Sur la classification botanique des dermatophytes, *Ann. Parasitol. Hum. Comp.* 2: 172-177.

—. 1925. Note sur le remplacement de tout sucre dans les milieux de culture des dermatophytes par le miel d'abeilles, *Ann. Derm. Syphiligr.* VI, **6**: 515-517.

—. 1928. Sur la nouvelle classification des dermatophytes proposée par M. Grigorakis, *Ann. Parasitol. Hum. Comp.* **6**: 455-469.

—. 1928-1929. Généralités concernant les dermatophytes. I, *Ann. Derm. Syphiligr.* VI, **9**: 656-669, 1928. II, *Ibid.* VI, **9**: 769-777, 1928. [À propos des tondantes à culture violette et des formes cliniques rares du favus]; *Ibid.* VI, **9**: 1030, 1031, 1928. III, Le problème des cultures glabres, *Ibid.* VI, **10**: 345-353, 1929. IV, [Classification]. *Ibid.* VI, **10**: 236-245, 1929. V, Le problème du pléomorphisme des cultures des dermatophytes, *Ibid.* VI, **10**: 481-486, 1929. VI, La classification naturelle des dermatophytes, *Ibid.* VI, **10**: 569-580, 1929.

—. 1929. Concernant les diverses classifications proposées pour les dermatophytes, *Ann. Parasitol. Hum. Comp.* **7**: 228-246, *Figs. 1-13.*

—. 1932. Diagnostic et traitement des affections du cuir chevelu. Masson et Cie, Paris, 579 pp.

Sabouraud, Raimond & Pablo Negroni. 1929. Aleuries et rudiments de fuseaux obtenus sur la culture d'Achorion Schoenleini, *Ann. Derm. Syphiligr.* VI, **10**: 232-235, *5 figs.*

Sabouraud, R., A. Suis & Felix Suffran. 1908. Fréquence du Microsporum caninum ou lanosum chez le chien et chez l'homme, *Ann. Derm. Syphiligr.* IV, **9**: 321-348, *9 figs.* [reprinted as La microsporie du chien, *Rev. Vét.* **66**: 1-14, 73-84, 137-149, *4 figs.*, 1909].

—. 1909. La "crête blanche" (favus) de la poule et son parasite, *Rev. Vét.* **66**: 601-613, 672-688, *15 figs.*

Sabrazés, Jean. 1893. Favus de l'homme, de la poule et du chien, *Ann. Derm. Syphiligr.* III, **4**: 340-346.

—. 1893. Pseudotuberculoses faviques expérimentales, *Ann. Derm. Syphiligr.* III, **4**: 414, 415.

—. 1896. Vitalité des spores du godet favique, démontrée par l'inoculation et la culture, *Cong. Franç. Méd. Bordeaux* 1895. **2**: 1013-1015.

Sabrazés, Jean & Brengues. 1898. Trichophytie profonde de la barbe. Étude historique, clinique et anatomopathologique, *Actes Soc. Linn. Bordeaux* **53**: 211-220, *Pl. 9.*

Saeves, Inga. 1916. Experimentelle Beiträge zur Dermatomykosenlehre, *Arch. Derm. Syphilis* **121**: 161-236, *Pl. 2.*

*Saint-Cyr. 1868. De la teigne faveuse du chien et du chat, *Jour. Méd. Vét.* **5**.

*—. 1869. Note complémentaire de la leçon sur la teigne faveuse des animaux, *Jour. Méd. Vét.* 395.

*—. 1869. Etude sur la teigne faveuse chez les animaux domestiques, *Rec. Méd. Vét. Prat.* 641.

Sartory, Antoine, G. Petges & R. Sartory. 1926. Étude d'une épidermomycose causée par l'agent de la teigne de la poule "Achorion gallinae" Sabrazés, *Bull. Acad. Méd.* **95**: 510.

Sartory, Antoine & R. Sartory. 1926. Les teignes exotiques, *Rev. Prat. Mal. Pays Chauds* **6**: 265-276.

Scatena, Giuseppe. 1925. Della tigna favosa nei primi giorni della vita, *Policlinico, Sez. Prat.* **32**: 591.

Schamberg, Jay Frank, Hermann Brown & Malcolm J. Harkins. 1931. The chemotherapy of ringworm infections. Preliminary report, *Arch. Derm. Syphilol.* **24**: 1033-1052.

Schamberg, Jay Frank & John A. Kolmer. 1922. Studies in chemotherapy of fungus infections. I. The fungistatic and fungicidal activity of various dyes and medicaments, *Arch. Derm. Syphilol.* **6**: 746-756.

Schertlin, Ernst. 1914. Eine Mikrosporieepidemie in Württemberg. *Inaug. Diss. Tübingen.* 13 pp.

Schmidt, P. W. 1933. Über die Pilzflora Westfalens insbesondere des Münsterlandes (Beiträge zur Klinik besonderer Erkrankungsformen bei Pilzerkrankungen, sowie über Doppelinfektionen mit verschiedenen Pilzarten, Zuchtung von Mikrosporon Audouinii aus dem strömenden Blute), *Arch. Derm. Syphilis* **167**: 418-447, *7 figs.*

—. 1933. Atypische Formen von Erkrankungen durch Trichophyton rosaceum und Achorion Quinckeanum (Palmarkeratosen, oberflächliche epidermophytieähnliche Veränderungen), *Arch. Derm. Syphilis* **167**: 671-688, *6 figs.*

—. 1933. Zur Pathogenese der Epidermophytien und Trichophytien der Hände und Füsse unter besonderer Berücksichtigung der ekzematoïden Hautveränderungen mit Kulturergebnissen in 732 Fällen, *Arch. Derm. Syphilis* **169**: 259-294, *9 figs.*

—. 1934. Über die Scherflechte bei Rindern (Die in Westfalen ursächlichen Trichophytonarten und durch sie hervorgerufenen atypischen Hauterscheinungen), *Derm. Woch.* **98**: 9-13, *3 figs.*

Schönfeld, W. 1921. Über autochton in Vorpommern enstandenen endemischen Favus und Massnahmen zu seiner Bekämpfung, *München. Med. Woch.* **68**: 1575-1577.

Scholtz, Moses. 1926. Trichophytosis of the glabrous skin as a clinical problem, *Med. Jour. Rec.* **123**: 379-382, 432, 433.

—. 1932. Epidermophytids as a clinical conception, *Arch. Derm. Syphilol.* **25**: 812-822.

Schrader, G. W. 1858. Über den Mäusefavus, *Arch. Path. Anat. Phys.* [Virchow] **15**: 382, 383.

Schramek, Max. 1910. Über Mikrosporie, *Wien. Klin. Woch.* **23**: 1712-1714.

—. 1912. Beiträge zur Trichophytie des Kopfes und der Nägel, *Arch. Derm. Syphilis* **113**: 975-986.

—. 1916. Befunde bei Pilzerkrankungen der Hände und Füsse, *Arch. Derm. Syphilis* **121**: 630-645.

Schreus, Hans Th. 1920. Über lichenoïde Eruption bei Pyodermie (Lichen pyodermicus) nebst Bemerkungen über Komplementablenkung im Blute bei Staphylokokken- und Trichophytie- Erkrankungen mit Berücksichtigung der Einwirkung von Röntgenstrahlen, *Derm. Zeitschr.* **31**: 272-281.

Scolari, E. 1931. Contributo allo studio della biologia dei dermatofiti. Considerazioni ed esperienze sull 'importanza del pH dei terreni di coltura, *Giorn. Ital Derm. Sifilol.* **72**: 323-360, *4 figs.*

*Scopesi, Mario. 1926. Sulla sostituzione del miele al maltosio e al glucosio nei terreni di Sabouraud, *Dermosifilografo* **4**: 274.

Scott, Ernest L. & Earl B. McKinley. 1930. Effect of ultraviolet light upon the genus Trichophyton, *Proc. Soc. Exp. Biol. Med.* **27**: 598, 599.

Scott, H. M. 1911. A report on seven hundred consecutive cases of tinea capitis, *Brit. Jour. Derm. Syphilis* **23**: 330-332.

Seemann, Desider & Edmund Rajka. 1923. Schwere Nagel-und oberflächliche Hand- und Fusstrichophytie. Trichophytid, entstanden in Anschlusse an die Impfung der Trichophytonpilzes, *Arch. Derm. Syphilis* **143**: 9-14.

Semon, H. C. 1922. Tinea unguium, *Brit. Jour. Derm. Syphilis* **34**: 397-400, *2 pls.*

Sequeira, James H. 1906. Extensive ringworm with ulceration of the umbilicus, *Brit. Jour. Derm. Syphilis* **18**: 269-274, *1 pl., 4 figs.*

Sézary & Georges Lévy. 1933. Teigne de l'adulte due au Microsporum felineum, *Bull. Soc. Franç. Derm. Syphiligr.* **40**: 218, 219.

Sharlit, Herman & Emanuel Muskatblit. 1933. A search for a new method for the determination of the fungicidal action of chemicals. Preliminary report, *Arch. Derm. Syphilol.* **25**: 615-623.

Sharp, William R. & Evelyn Kerns Taylor. 1928. Interdigital ringworm control among students, *Jour. Prev. Med.* **2**: 485-491.

Shaw, Frederick W. & Frederick J. Wampler. 1933. Mouse favus, *Virginia Med. Monthly* **59**: 742-745, *6 figs.*

Sicoli, A. 1924. Dyshidroses vraies et pseudo-dyshidroses, *Ann. Derm. Syphiligr.* VI, 5: 69-84, *7 figs.*

Siemens, H. W. & J. H. Broekema. 1934. Favus bestrijding in Nederland, *Nederl. Tijdschr. Geneesk.* 78: 153-165.

Silva, Richard de. 1921. Dhobie itch produced by inoculating a culture of Epidermophyton rubrum (Castellani 1909), *Jour. Trop. Med. Hyg.* 24: 303.

Simon, August. 1927. Über Mäusefavus, *Derm. Zeitschr.* 50: 36-38.

Smolka. 1928. Experimentelle Beiträge zur Frage der hämatogenen Dermatomykosen, *Arch. Derm. Syphilis* 154: 519-531.

*Soboleff. 1925. Trichophytiestatistik in Charkow Vrachebnoe Delo, *Nauchnyĭ Med. Zhurnal Kharkof* 8: 645.

Soetomo, Raden. 1924. Microsporie bei Javanichen kinderen en hare epidemiologie, *Geneesk. Tijdschr. Nederlandsch. Indië* 64: 720-725.

—. 1924. Favus in Indië, *Geneesk. Tijdschr. Nederlandsch. Indië* 64: 546-549, *1 pl.*

Soltmann, Heinz. 1922. Über Mäusefavus beim Menschen, *Derm. Woch.* 75: 869-874, 920-925, *Figs. 1-5.*

—. 1924. Die Pilzflora an der Leipziger Hautklinik, *Deutsch. Med. Woch.* 50: 201, 202.

Soltmann, Heinz & O. Dietze. 1924. Über eine in Leipzig beobachtete Mikrosporieendemie, *Derm. Woch.* 78: 601-611.

*Sorokin. 1931. *Venereol. Derm.*

Spaar, Eric C. 1921. Notes on Monilia metalondinensis (Castellani 1916) and Epidermophyton rubrum (Castellani 1909), *Jour. Trop. Med. Hyg.* 24: 126, 127.

Sprecher, Florio. 1910. Favus bei Neugeborenen, *Arch. Derm. Syphilis* 99: 389-396.

—. 1930. La tigna nell'adulto, *Giorn. Ital. Derm. Sifilol.* 71: 1956-1968.

Spring, Dorothy. 1931. Morphologic variation within the same species of dermatophyte, as observed in hanging drop cultures, *Arch. Derm. Syphilol.* 23: 1076-1086.

—. 1931. Heterothallism among the dermatophytes, an inquiry into three of the common species, *Arch. Derm. Syphilol.* 24: 22-38, *5 figs.*

Stauffer, Hans. 1928. Über einen Fall von ekzematoiden und später furunkuloidem Trichophytid, *Arch. Derm. Syphilis* 154: 231-238, *1 fig.*

Stein, Albrecht. 1933. Über eine erneute Mikrosporie-endemie in Dresden, *Arch. Derm. Syphilis* 167: 461-470.

Stein, Robert Otto. 1911. Zur Epidemiologie der Mikrosporie in Wien, *Wien. Klin. Woch.* 24: 308-310, *1 fig.*

—. 1912. Die spezifische Behandlung der tiefen Trichophytie, *Wien. Klin. Woch.* 25: 1817-1821.

—. 1921. Cutireaktion bei Favus, *Arch. Derm. Syphilis* 132: 294-303, *1 fig.*

Stern, Edmund. 1898. Über einige bisher noch nicht beschriebene Formen von Herpes tonsurans, *Arch. Derm. Syphilis* 44: 281-292, *Pl. 35.*

Sternthal, Alfred. 1912. Mikrosporie-Epidemie unter Braunschweiger Schulkindern, *Arch. Derm. Syphilis* 113: 1103-1112.

Strandberg, James. 1917. Om en svampsjukdom å hander och fötter, *Svenska Läkaresällskapets Handl.* 43: 913-916 [Alfred Petterson Festschrift].

Strickler, Albert. 1933. Fungicidal properties of certain clinically recognized fungicides. Laboratory determinations using the Strickler-Borneman apparatus and the Henal vacuum vaporizer, *Arch. Derm. Syphilol.* 28: 836-840.

Strickler, Albert & Reuben Friedman. 1931. Symptomatic and asymptomatic ringworm of the feet, a report based on a study of one thousand seventy-three consecutive cases in the dispensary covering a period of one year, *Arch. Derm. Syphilol.* 24: 430-445.

Strickler, Albert & William H. McKeever. 1934. Recurrence of infection of the feet due to ringworm fungus, *Arch. Derm. Syphilol.* 29: 526-528.

Strickler, Albert, Edward A. Ozellers, & Ralph P. Zaletel. 1932. Modern interpretation of mycotic infections of the feet and hands, *Arch. Derm. Syphilol.* 25: 1028-1040, *2 figs.*

Stümpke, Gustav. 1922. Über den weiteren Verlauf der Hannoverschen Mikrosporie-Epidemie, *Derm. Woch.* 74: 472-475.

Suis, A. 1909. Un cas de contagion du Microsporum lanosum du chien à l'enfant, *Ann. Derm. Syphiligr.* IV, 10: 114, 115.

Suis, A. & Felix Suffran. 1908. Note préliminaire sur le Microsporum lanosum du chien, *Ann. Derm. Syphiligr.* IV, 9: 151, 152.

Sulzberger, Marion B. 1928. The pathogenesis of trichophytids, the spontaneous passage of formed elements (spores) from the primary lesion into the circulating blood, *Arch. Derm. Syphilol.* 18: 891-901.

—. 1929. Experimentelle Untersuchungen über die Dermatotropie der Trichophytonpilze, *Arch. Derm. Syphilis* 157: 345-357.

—. 1930. Allergy in infectious diseases of the skin, *Med. Jour. Rec.* 131: 264-266.

Sutter, Ernst. 1917. Weitere Beiträge zur Lehre von der Immunität und Überempfindlichkeit bei Trichophytie-Erkrankungen, *Derm. Zeitschr.* 24: 65-99.

—. 1919. Zur Kenntnis der Pathogenese der Trichophytide, *Arch. Derm. Syphilis* 127: 735-761.

Swartz, J. H. 1923. Report of four cases of favus in one family, *Boston Med. Surg. Jour.* 189: 507-509, *4 figs.*

—. 1923. Primary favus of the nails, *Arch. Derm. Syphilol.* 8: 559.

Symes, J. Odery. 1909. An epidemic of tinea cruris, *Brit. Med. Jour.* 1: 1109.

Synghellakis, Alexandre. 1926. Un cas d'eczéma marginé à localisation rare, *Rev. Franç. Derm. Vén.* 2: 15, 16.

Szathmáry, Sebastian. 1929. Über eine durch den Kaufmann-Wolfschen Pilz verursachte Epidermophytosis, *Derm. Woch.* 89: 1769-1776.

*Szulmeister. 1930. De l'influence de la température sur le développement des champignons pathogènes des poils, *Przeglad Dermatologiczny.* 25: 442.

*Takahashi, K. 1929. Trichophytie in Hokuriku-Provinz, *Ju-zen-kai-Zasshi, Kanazawa Univ.* 34: 5.

*Takahashi, Sh. 1923. A contribution to the immunity and allergy in trichophytosis, *Jap. Jour. Derm. Urol.* 23: 462.

*—. 1924. A contribution to the knowledge of pompholyx and trichophytia pompholyciformis and trichophytosis in Korea, *Jap. Jour. Derm. Urol.* 24.

*—. 1925. A contribution to the knowledge of dysidrosis, *Jap. Jour. Derm. Urol.* 25: 38.

—. 1925. Über die trichophytie und die trichophytonarten in Chōsen, *Jap. Jour. Derm. Urol.* 25: 251-286 [74, 75.]

—. 1928. Über Trichophytie und ihre Erreger in Sapporogegend, *Jap. Jour. Derm. Urol.* 28: 542-550, *3 figs.*

—. 1929. Biologische Studien über die Trichophyten, *Jap. Jour. Derm. Urol.* 29: 134-150 [German summary 14, 15].

*Takahashi, Sh. & Takemura. 1923. On the effect of ultraviolet light upon trichophytosis and Trichophyton, *Jap. Jour. Derm. Urol.* 23: 349-351.

*Takahashi, Sh. & T. Takenouchi. 1924. Studien über Favus der unbehaarten Körperteile, *Jap. Jour. Derm. Urol.* 24: 217, 335.

*—. 1924. On favus in Hoku-etsu-region, *Jap. Jour. Derm. Urol.* 24: 489.

Takasaki, S. 1927. Contribution to the etiology of tinea imbricata, *Acta Derm. Kyoto* 10: 512-522, *2 pls.*

Takasugi, S. 1918. Studie über Dermatomycosis in Südseeinseln, *Jap. Zeitschr. Derm. Urol.* 18: 311-338.

*Takenouchi, T. 1924. On varieties of Trichophytons distributed in Niigata Province, *Jap. Jour. Derm. Urol.* 24.

*—. 1925. A contribution to the knowledge of onychomycosis and favus, *Jap. Jour. Derm. Urol.* 25.

*—. 1926. Ein Beitrag zur Studie der Trichophytie besonders über die Trichophytie-Erkrankungen in der Provinz Niigata, *Hokuetsu Igaku Kai Zasshi* **41**: 3.

—. 1927. Über die Verhältnisse der Wasserstoffsionenkonzentration zur Kultivierung der Hyphomyceten, *Jap. Jour. Derm. Urol.* **27**: [29].

*Takeya, Minoru. 1924. On the position of Trichophyton in botanical classification, *Jap. Jour. Derm. Urol.* **24**.

—. 1925. Studien über die Trichophytien in Japan, *Tohoku Jour. Exp. Med.* **6**: 75-129, *Pls. 1-14.*

*—. 1926. Trichophytia capilitii caused by Trichophyton purpureum, *Jap. Jour. Derm. Urol.* **26**: 7.

Talice, Rodolfo V. 1931. Sur une souche de Trichophyton ferrugineum (Ota 1921) (Microsporum ferrugineum Ota, 1921) isolée à Montevideo, *Ann. Parasitol. Hum. Comp.* **9**: 77-86, *3 figs.*

Talice, Rodolfo V. & Juan E. Mackinnon. 1931. Dermatomicosis por Microsporum (Sabouraudites) en el Uruguay, *Soc. Biol. Montevideo*, 53 Sesión, 12 pp., *1 table.*

—. 1931. Sabouraudites (Microsporum) parasites de l'homme en Uruguay, *C. R. Soc. Biol.* **107**: 883, 884.

—. 1931. Dermatomicosis por Trichophyton (Géneros Trichophyton y Ctenomyces) en el Uruguay, *Soc. Biol. de Montevideo* 54 Sesión. 8 pp., *1 table.*

—. 1931. Trichophyton parasites de l'homme en Uruguay, *C. R. Soc. Biol.* **107**: 1549, 1550.

—. 1931. Observaciones sobre la intradermo-reacción con toxinas micósicas (dermatofitinas) en las dermatomicosis, *Arch. Soc. Biol. Montevideo* **3**: 174-179.

—. 1931. Dos casos de epidermomicosis dishidriforme debidas al ''Epidermophyton floccosum'' (Harz 1873)—''Epidermophyton cruris'' (Castellani), *Arch. Soc. Biol. Montevideo.* **3**: Suppl. Fasc. V: 1371-1375.

Talice, Rodolfo V., J. E. Morelli & V. Calzada. 1931. Nouvelle technique pour l'inoculation des Trichophyton faviformes au Cobaye, *C. R. Soc. Biol.* **108**: 903, 904.

*Tamura, H. & S. Taniguchi. 1923. On pompholyx, *Jap. Jour. Derm. Urol.* **23**: 21.

*Tanaka. 1914. *Mitt. Med. Ges. zu Tokyo* **28**.

*Taniguchi, S. 1925. A different kind of Grubyella (Achorion) Schoenleini, *Jap. Jour. Derm. Urol.* **25**: 38.

Taniguchi, Yoshiakira. 1926. Beiträge zur Studie der Dyshidrosis, *Jap. Jour. Med. Sci. Derm.* **1**: 43-74, *Pl. 1.*

*—. 1927. *Jap. Jour. Med. Sci. Trans. XIII, Derm. Urol.* **1**: 92.

Tarantelli, Eugenio. 1930. Ricerche micologiche nella provincia di Roma, *Arch. Ital. Derm. Sifiligr. Venereol.* **5**: 391-400.

Tate, P. 1929. The dermatophytes or ringworm fungi, *Biol. Rev.* **4**: 41-75, *Pls. 1-7.*

—. 1929. On the enzymes of certain dermatophytes or ringworm fungi, *Parasitology* **21**: 31-54.

Teodorescu, St. 1926. Première épidémie de microsporie en Roumanie, *C. R. Soc. Biol.* **95**: 407, 408.

—. 1927. Étude sur une première épidémie de microsporie en Roumanie, *Rev. Franç. Derm. Vén.* **3**: 142-146, *1 fig.*

*Thanshimenganz. 1910. Experimentell biologische Untersuchungen über Immunität und Allergie bei Hyphomyceten-Erkrankungen, *Inaug. Diss. Basel.*

Thibierge, G., P. Légrain & Ch. Leblois. 1925. Transmissions aux parties glabres de l'homme du ''Microsporum felineum,'' *Bull. Soc. Franç. Derm. Syphiligr.* **32**: 262-267.

Thomson, M. Sydney. 1925. Cat ringworm, *Brit. Jour. Derm. Syphilis* **37**: 269, 270.

Toma, Anton. 1929. Sur l'infection des cheveux in vitro par les champignons des teignes, *Ann. Derm. Syphiligr.* VI, **10**: 641-643.

Tomasczewski, E. 1910. Über Achorion Quinckeanum. Ein Beitrag zur Favusfrage, *Derm. Zeitschr.* **17**: 359, 360.

—. 1911. Kulturelle und experimentelle Untersuchungen über Achorion Schoenleini und Achorion Quinckeanum, *Derm. Zeitschr.* **18**: 887-903, *Pl. 14.*

Tornabuoni, Giuseppe. 1926. Su di una epidemia da Trichophyton equinum, *Giorn. Ital. Derm. Sifilol.* **67:** 1051-1058, *3 figs.*

Trachsler, Frau Dr. 1896. Vorkommen der Mikrosporie in Hamburg, *Monatsh. Prakt. Derm.* **26:** 273-284.

Tribondeau. 1899. Le tokelau dans les possessions françaises du Pacifique oriental, *Arch. Méd. Navale.* **72:** 5-52.

Truffi, Mario. 1902. Un caso di cherion dovuto all'Achorion di Schoenlein. Granuloma del tessuto cutaneo provocato dall'Achorion, *Giorn. Ital. Mal. Ven. Pelle* **43:** 491-500, *1 pl.*

—. 1907. Hyphomycète du type Achorion determinant chez l'homme des lesions trichophytioïdes, *Arch. de Parasitol.* **11:** 419-424.

—. 1912. Tricofizia ungueale, *Giorn. Ital. Mal. Ven. Pelle* **53:** 114-119.

—. 1914. Favo della palpebra da Achorion gypseum, *Giorn. Ital. Mal. Ven. Pelle* **55:** 330, 331.

—. 1921. Un caso di favo delle cute glabra dovuto all'Achorion α di Quincke, *Pathologica* **13:** 255-259.

—. 1923. Favo da Achorion gypseum, *Giorn. Ital. Mal. Ven. Pelle* **64:** 557-563.

—. 1925. Tigna microsporica in Sicilia, *Areh. Ital. Derm. Sifiligr. Venereol.* **1:** 197-202.

—. 1927. Sul pleomorfismo dell'Epidermophyton inguinale, *Giorn. Ital. Derm. Sifilol.* **68:** 745, 746.

—. 1928. On the pleomorphism of the Epidermophyton inguinale, *Urol. Cut. Rev.* **32:** 781-783.

—. 1930. Contributo ai problemi delle dermatomicosi sperimentali, *Giorn. Ital. Derm. Sifilol.* **71:** 999-1004.

Tzschirntsch, Kurt. 1927. Über Favus corporis durch Achorion gypseum, *Derm. Zeitschr.* **51:** 331-335, *2 figs.*

Unna, Paul G. 1894. Natürliche Reinkulturen der Oberhautpilze, *Monatsh. Prakt. Derm.* **18:** 257-267.

Unna, Paul G., Jr. 1918. Zur Trichophytiefrage, *Derm. Woch.* **66:** 335-337.

Urbain, Achille. 1929. Sur la durée de la vitalité et de virulence de Trichophyton gypseum incoporé à des litières, *C. R. Soc. Biol.* **99:** 1917-1919.

*Urbain, Achille, J. Barotte & H. B. Capdebielle. 1926. Sur un cas de teigne equine due à l'Achorion gypseum, *Bull. Mém. Soc. Centr. Méd. Vét.* **102:** 50.

Urechia, C. I. & C. Tartaru. 1923. Encéphalite favique et trichophytique, *Rev. Neurol.* **2:** 231-236, *8 figs.*

*Uriburu, Julio Vincente. 1909. Contributión al estudio de los tinas en Buenos Aires, *Argentina Med.*

Urueña, J. G. (see Gonzales Urueña, Jesus).

Vámos, L. 1932. Pilze und Wasserstoffionenkonzentration, *Derm. Zeitschr.* **63:** 345-350.

Vasconcellos, Figueiredo. 1914. Contribuição para o estudo das dermatomicoses no Brasil. I. Trichophyton griseum n. sp., *Mem. Inst. Oswaldo Cruz* **6:** 11-17, *Pls, 2, 3.*

Verujski, Dmitri. 1887. Recherches sur la morphologie et la biologie du Trichophyton tonsurans et de l'Achorion Schoenleinii, *Ann. Inst. Pasteur* **1:** 369-391.

Vidal. 1879. [Parasite de pityriasis, eczéma marginé], *C. R. Soc. Biol.* **31:** 3, 4.

—. 1888. Un cas de contagion naturelle de la teigne tonsurante du boeuf à l'homme, *Rev. Vét.* [Toulouse] **13:** 299-303.

Vigne, Paul. 1926. Emploi de la lumière ultra-violette de Wood pour la dépistage des teignes, *Marseille Méd.* **63:** 1765-1768.

—. 1926. La lumière ultra-violette de Wood, ses propriétés, ses applications en hygiène, en ophthalmologie et en dermatologie, *Marseille Méd.* **63:** 585, 586.

—. 1927. Utilisation de la lumière ultra-violette de Wood pour la dépistage des teignes tondantes et du favus, *Presse Méd.* **35:** 339-341.

Vignolo-Lutati, Carlo. 1917. Contributo allo studio della tricofizia ungueale familiare. Onicomicosi da Trichophyton effractum e da Trichophyton plicatile, *Giorn. Ital. Mal. Ven. Pelle* **58:** 54-68, *1 pl.*

Villain, G. 1925. Le tokelau (tinea imbricata) dans la province chinoise du Honan, *Bull. Soc. Path. Exot.* 18: 618-622.

Vrieze, T. J. de. 1924. Favus in Indië, *Geneesk. Tijdschr. Nederlandsch. Indië* 64: 726, 727.

Vuillemin, Paul. 1895. Structure et affinité des Microsporum, *Bull. Soc. Myc. France* 11: 94-103.

—. 1925. Classification normale, classement auxiliaire et groupement pratique des champignons, *C. R. Acad. Sci.* 180: 102-106.

Waelsch, Ludwig. 1895. Zur Anatomie des Favus, *Arch. Derm. Syphilis* 31: 48-64, *Pls. 5, 6.*

—. 1896. Über die Mannigfaltigkeit der Wachstumsformen (Cult. Pleomorphismus) der pathogenen Schimmelpilze, insbesondere des Pilzes des Eczema marginatum, *Arch. Derm. Syphilis* 37: 3-38, *Pls. 1, 2.*

Walthard, B. 1928. Zur Pathogenese des dysidrotischen Symptomenkomplexes. Über ein unter dem Bilde einer Dysidrosis verlaufendes Epidermophytid, *Derm. Zeitschr.* 53: 692-706.

*Wandel. 1903. Zur Frage des Tier- und Menschenfavus, *Deutsch. Arch. Klin. Med.* 76: 520.

Weidman, Frederick D. 1924. The relation of fungi to disease. With demonstration of 40 of the known cutaneous species, *Proc. Path. Soc. Philadelphia* 27: 55-57 [**Rept. Lab. & Mus. Comp. Path. Zool. Soc. Philadelphia* 40, 1925].

—. 1926. Morphologic variations in a ringworm species of the toes, followed in primary cultures over a period of years, *Arch. Derm. Syphilol.* 13: 374-382.

—. 1927. Laboratory aspects of epidermophytosis, *Arch. Derm. Syphilol.* 15: 415-450.

—. 1928. Dermatophytosis—the newer ringworm, *Jour. Am. Med. Ass.* 90: 499-502.

—. 1928. Comparison of ringworm culture ingredients. II. The nitrogen factor, *Arch. Derm. Syphilol.* 18: 829-837.

Weidman, Frederick D. & Thomas M. Macmillan. 1921. A comparison of ingredients of ringworm culture mediums with special reference to American and French crude maltose, *Arch. Derm. Syphilol.* 4: 451-468, *16 figs.*

Weidman, Frederick D. & Dorothy Spring. 1928. A comparison of ringworm culture ingredients. III. Grütz Goldschmitt Sabouraud (Honey modification) Sabouraud's glycerin and certain synthetic medium, *Arch. Derm. Syphilol.* 18: 837-850.

Weiss, Emanuel. 1930. Über das Verhalten der Pilze bei verschiedenen Temperaturen, *Arch. Derm. Syphilis* 162: 260, 261.

Weiss, Richard S. 1917. A case of Epidermophyton infection of the scalp, *Jour. Am. Med. Ass.* 69: 1059, 1060, *6 figs.*

Wende, Grover W. & Katharine R. Collins. 1921. A contribution to the study of Epidermophyton inguinale. Notes on an inquiry into the morphology of the causative fungi; a clinical and laboratory study of 37 cases of dermal scaling, *Arch. Derm. Syphilol.* 3: 1-13.

Werneck Machado, & Parreiras Horta. 1918. Sycose parasitaria do bigode, *Brasil Med.* 32: 84.

Werther. 1903. Ueber eine Epidemie von Trichophytie des Kopfes bei Schulkindern, *Monatsh. Prakt. Derm.* 36: 109-121, *8 figs.*

—. 1931. Über die Dresdener Epidemie von Mikrosporie und Alopecia parvimaculata und Deutung der letzteren als Mikrosporid, *Arch. Derm. Syphilis* 163: 402-419, *6 figs.*

Wever, Theodor M. 1919. Über autochthonen Favus im Rheinland, *Inaug. Diss. Bonn*, 39 pp.

White, Charles J. 1919. The question of Epidermophyton infection, a problem in dermatological diagnosis, based on a study of one hundred and ninety-two private cases, *Jour. Cut. Dis.* 37: 501-516.

—. 1927. Fungus diseases of the skin, clinical aspects and treatment, *Arch. Derm. Syphilol.* 15: 387-404.

White, Charles J. & Arthur M. Greenwood. 1921. Epidermophytosis, *Jour. Am. Med. Ass.* **77**: 1297-1302. [*Wisconsin Med. Jour.* 24: 1-9, 1925.]

White, Cleveland. 1928. Studies in mycotic dermatitis. II. Mycotic inguinal lymphadenitis associated with superficial fungus dermatitis of the feet, *Arch. Derm. Syphilol.* **18**: 271-275.

—. 1928. Dermatophytosis of extremities associated with peripheral occlusive endocarditis, *Jour. Am. Med. Ass.* **90**: 1865-1867.

—. 1929. Ringworm of the scalp in adults (report of two cases), *Illinois Med. Jour.* **56**: 152, 153.

—. 1929. Auto-inoculation dermatophytosis from toe cultures, clinical, laboratory, experimental and therapeutic studies in superficial mycotic dermatitis, *Arch. Derm. Syphilol.* **20**: 315-319.

—. 1929. Superficial fungus dermatitis of the glabrous skin; general aspects of clinical and laboratory findings in 1,024 cases with therapeutic notes, *Wisconsin Med. Jour.* **28**: 342-346.

Whitfield, Arthur. 1908. A note on some unusual cases of trichophytic infection, *Lancet* **86**: 2: 237, 238.

—. 1911. A series of ringworm cultures illustrating the eczematoid ringworm of the hands and feet, *Proc. Roy. Soc. Med. Derm. Sect.* **4**: 111, 112.

—. 1928. Eczematoid ringworm, *Med. Press and Circular* **176**: 219-223.

Whitfield, Arthur, Raimond Sabouraud, et al. 1911. Eczematoid ringworm of the extremities and the groin, *Brit. Jour. Derm. Syphilis* **33**: 375-402, *Pl. 12* [reprinted *Proc. Roy. Soc. Med.* **5**: *Derm.* 36-62, 1911].

Wieder, L. M. 1933. Modern methods in diagnosis and treatment of the common fungous diseases of the skin, *Wisconsin Med. Jour.* **32**: 235-241.

Wilenczyk, Alexander. 1926. Le Trichophyton en goutte pendante, *C. R. Soc. Biol.* **94**: 201-204, *3 figs.*

—. 1926. Le Trichophyton en goutte pendante, *Ann. Inst. Pasteur* **40**: 732-742, *7 figs.*

—. 1927. Le Trichophyton et ses variétés en Pologne, *C. R. Soc. Biol.* **96**: 349-352, *2 figs.*

—. 1927. Sur la formation d'asques dans le Trichophyton, *Ann. Inst. Pasteur* **41**: 1351-1356, *6 figs.*

—. 1928. Formation des asques dans les cultures de Trichophyton [granulosum], *C. R. Soc. Biol.* **98**: 70, *1 fig.*

—. 1928. La formation d'asques chez Achorion Schoenleini (favus), *C. R. Soc. Biol.* **98**: 1049, 1050, *1 fig.*

—. 1928. Du polymorphisme et du pléomorphisme des teignes, *C. R. Soc. Biol.* **99**: 1025, 1026, *1 fig.*

—. 1928. Sur la présence d'asques dans les squames des éruptions de mycoses (favus et trichophytie et de séborrhée), *C. R. Soc. Biol.* **99**: 1027, *1 fig.*

—. 1930. Über die Variabilität des Trichophyton violaceum, *Arch. Derm. Syphilis* **161**: 20-23, *4 figs.*

Williams, Charles Mallory. 1922. The diagnosis of some eruptions on the hands and feet, *Arch. Derm. Syphilol.* **5**: 161-173, *4 figs.*

—. 1926. Dermatophytid complicating dermatophytosis of the glabrous skin, *Arch. Derm. Syphilol.* **13**: 661-669.

—. 1927. The enlarging conception of dermatophytosis, *Arch. Derm. Syphilol.* **15**: 451-469.

—. 1930. Dermatophytid complicating tinea cruris, *Arch. Derm. Syphilol.* **22**: 637-641.

—. 1931. Tinea barbae involving the upper lip and accompanied by dermatophytid, *Arch. Derm. Syphilol.* **23**: 213-220.

—. 1933. Trichophytid of the hands, *Arch. Derm. Syphilol.* **27**: 973-975.

Williams, Charles Mallory & Else A. Barthel. 1929. Tinea of the toenails as a source of reinfection in tinea of the feet, *Jour. Am. Med. Ass.* **93**: 907-910.

Williams, Charles Mallory & Cedric C. Carpenter. 1932. Trichophytin in diagnosis, *Arch. Derm. Syphilol.* **25**: 846-851.

Winkler, Max. 1919. Über die Mikrosporieepidemie in Luzern, *Corresp. Bl. Schweiz. Ärzte* **49**: 1497-1502.

Wise, F. & Marion B. Sulzberger. 1930. Urticaria and hay fever due to trichophytin (Epidermophyton interdigitale), *Jour. Am. Med. Ass.* **95**: 1504.

Wucherpfennig, V. 1932. Über Favus und seine Behandlung. Zugleich ein Beitrag zur Frage der Summationswirkung von Röntgen und U. V. Strahlen, *Arch. Derm. Syphilis* **166**: 117-135, *4 figs.*

Yi, Li Hsueh. 1933. Die Wachstum verhindernde und abtötende Wirkung verschiedener chemischer Mittel auf Epidermophyton rubrum, Epidermophyton interdigitale und Trichophyton pedis A und B [tr. Ernst Levin], *Derm. Woch.* **97**: 1526-1532, *2 figs.*

Zander. 1858. Über Epiphyten des Menschen und der Tiere, *Arch. Path. Anat. Physiol.* [Virchow] **14**: 569-571.

Zifferblatt, Arnold H. & Henry K. Seelaus. 1933. Pilztötende Wirkung von Joddämpfen zugleich ein Bericht über ihre Beziehungen zur Behandlung von Hyphomykosen beim Menschen, *Arch. Derm. Syphilis* **169**: 442-450, *4 figs.*

Zingale, Michele. 1923. Sulle epidermomicosi delle mani e dei piedi (simulanti l'eczema, la disidrosi, l'intertrigine) con speciale riferimento a due esse descritte da Kaufmann-Wolf, *Giorn. Ital. Mal. Ven. Pelle* **64**: 929-946.

Zollikoffer, R. & O. Wenner. 1908. Über eine St. Galler Mikrosporie-Epidemie, *Corresp. Bl. Schweiz. Ärzte* **38**: 553-564.

Zollschan, I. 1924. Die Favus Ausrottungsaktion in Ost-Europa, *Med. Klin.* **20**: 100-102.

Zumbusch, L. v. 1923. Parasitäre Hautkrankheiten, *München. Med. Woch.* **70**: 368-370.

CHAPTER XVII

ASPERGILLACEAE

The simplest member of this family, *Aphanoascus cinnabarinus,* is found on decaying feathers and dung. The cells are multinucleate and the hyphae abjoint lateral or terminal, hyaline, ovoid, multinucleate conidia. The formation of the perithecium is much as in the Gymnoascaceae. The multinucleate copulation branches arise from neighboring cells of the same hypha or from two separate hyphae. They undergo several nuclear divisions. The ascogonium is slender and coils as a helix around the spherical antheridium (Fig. 88, *1*). Fertilization is absent; the male nuclei degenerate; the ascogonium develops parthenogenetically, dividing into binucleate cells; some of these grow to ascogenous hyphae which coil helically and form lateral secondary branches which again coil helically. The whole system is abjointed into binucleate cells from which, apparently, the asci develop as lateral outgrowths (Fig. 88, *3*). Meanwhile the knot is closely surrounded by sheath hyphae intertwining at the periphery into a pseudoparenchymatous wall of several layers. The perithecia are hyaline at first, becoming yellowish brown and finally cinnabar red and up to 2 mm. in diameter (Dangeard 1907).

There has been much controversy concerning the development of *Monascus purpureus* and *M. Barkeri,* originally isolated from red Chinese rice, since found in ensilage and preserves. As far as one can learn from the conflicting accounts, the development is probably as follows: the mycelium consists of regularly branched hyphae which cut off spherical or pyriform conidia either singly or basipetally in chains. Both hyphal cells and conidia are multinucleate. The antheridium consists of a 4-8 nucleate terminal cell which is abjointed and undergoes no further differentiation (Fig. 89, *1*). Directly under the septum the ascogonial mother cell is abjointed and coils helically about the antheridium (Fig. 89, *2*). It is further divided into a 3-4 nucleate terminal cell, the trichogyne, and a 4-6 nucleate basal cell, the ascogonium (Fig. 89, *3*). The nuclei of the trichogyne degenerate. Usually the antheridium forms a papilla toward the trichogyne and fuses with it, and the male nuclei migrate into the trichogyne (Fig. 89, *4*). Thereupon the wall between trichogyne and ascogonium is temporarily dissolved, the nuclei migrate into the ascogonium, pair with the female nuclei, and migrate into the ascogenous hyphae (Fig. 89, *5*, *6*). The antheridium collapses and disintegrates.

Meanwhile the cell group has become closely surrounded by sterile sheath hyphae which apparently nourish the swollen spherical ascogonium and hence are gradually dissolved in the center of the fructification (Fig. 89, *6*). The peripheral layers are brown and pseudoparenchymatous, forming the perithecial wall (Fig. 89, *11*). The ascogenous hyphae divide into binucleate cells which swell directly to 8-spored asci (Fig. 89, *7-10*), according to Dangeard, while Schikorra describes them as having an ascogenous hypha similar to that of *Pyronema*. In this form we have a differentiation of the female copulation branch into a receptive cell, the trichogyne, and the true gametangium, the ascogonium proper.

In the closely related *Magnusia nitida* (Satina 1923) the cells are uninucleate, and the imperfect stage often forms coremia as in *Penicillium*. The multicellular trichogyne grows toward the unicellular antheridium, twines around it, and fuses with it. The contents of the antheridium pass into the trichogyne and thence to the ascogonium. The latter develop ascogenous hyphae of the crozier type. The perithecia are shining, black, ellipsoid or irregularly angular, with long spiral appendages which begin below the surface of the perithecium. This highly developed type is very close to that of the higher Ascomycetes.

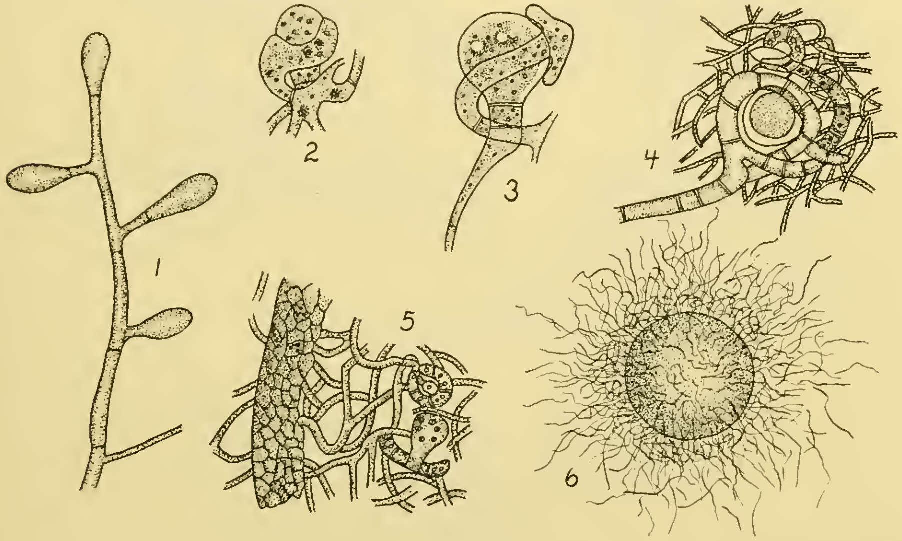

Fig. 88.—*Aphanoascus cinnabarinus.* *1,* conidiophore and conidia; *2,* small ascogonium coils about spherical antheridium; *3, 4,* later stages; *5,* section of periphery of an immature perithecium. The cells of the ascogenous hyphae are about to develop laterally to asci; *6,* mature fructification (*1-5* ×900; *6* ×15). (After Dangeard 1907.)

The other series of developmental forms has diverged from the main line but is of greater interest to the medical man, since in this line many pathogens are found, especially in *Aspergillus* and *Scopulariopsis,* perhaps also in *Penicillium.* Many species of this group are industrially important on account of their hydrolysis of starch, sugars, and tannins and their fermentations which produce oxalic, citric, and gallic acids, more rarely alcohol; e.g., *Aspergillus Oryzae,* which furnishes the taka diastase of commerce, *A. Wentii* used in the manufacture of soy bean sauces, etc. *Penicillium Roqueforti* and *P. Camemberti* lend to the corresponding cheeses their characteristic textures and flavors. A few species are mild facultative parasites of plants, although the genera as a whole are predominantly saprophytic.

In *Aspergillus* the mycelium is mostly submerged, with only the conidiophores rising above the surface. In *Penicillium* both submerged and aerial mycelium usually occur. The aerial mycelium is usually colorless, unless colored crystals are deposited on the walls of the hyphae. The submerged mycelium often shows a brilliant color. Since this is usually observed from

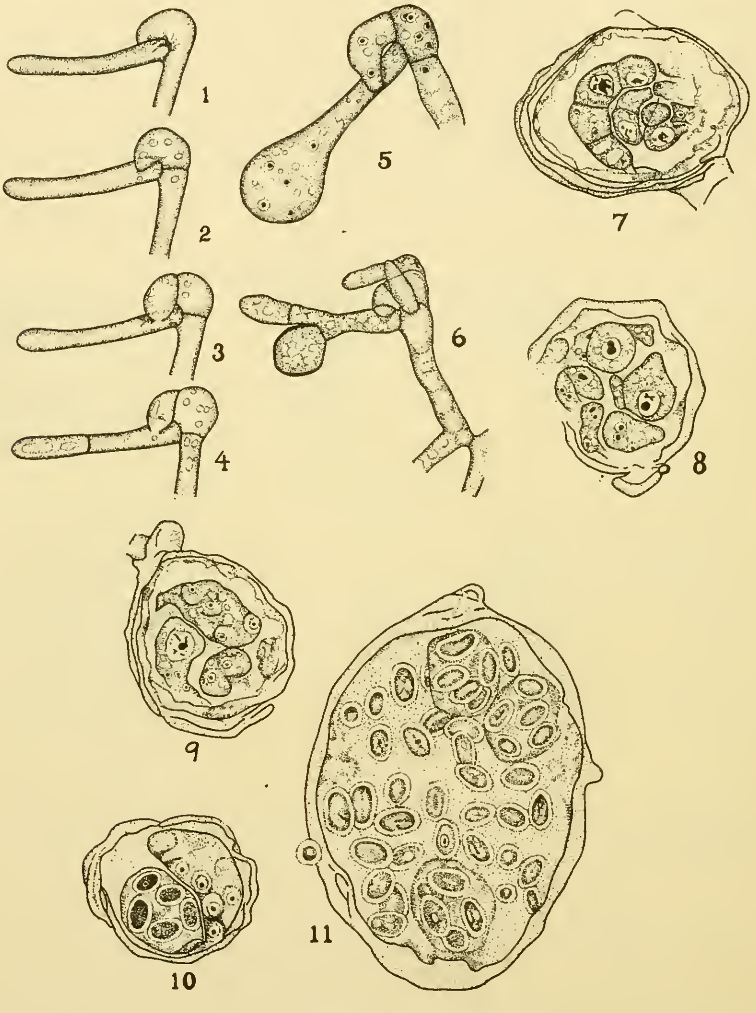

Fig. 89.—*Monascus ruber*. *1-4*, stages in the development of sexual organs; *1*, antheridium pushed aside by young female organ; *2*, female organ curving over antheridium and separated from the main hypha by a septum; *3*, female organ divided into ascogonium and trichogyne; *4*, fusion of antheridium and trichogyne; *5*, later stage; *6*, early stage of perithecial formation, in which the ascogonium is being enveloped by sterile hyphae, arising from the stalk below; *7*, a wall enclosing a septate ascogenous hypha of which both the end and second cells have formed asci with conspicuous nuclei. Other young asci are present, one still in a binucleate condition; *8*, perithecium containing binucleate ascogenous hypha, three asci having associated nuclei in various stages of fusion and one ascus with clearly defined nucleus with nuclear reticulum around ascus; *9*, ascus containing four visible ascospores being formed, part of a second ascus in a similar condition, and a third with a large resting nucleus; *10*, two asci in a small perithecium, one showing fibers from near the wall of the ascus gradually surrounding nuclei and some cytoplasm, the other enclosing ripe ascospores and residual cytoplasm; *11*, almost mature perithecium showing asci and ascospores lying free in the perithecial cavity. (After Young 1931.)

the underside of the slant or Petri dish, it is often described as color of the reverse in taxonomic literature. Color production may be influenced by changing the nutrient, often without apparently injuring the vigor of the mold and may often be increased by increasing the concentration of some fermentable nutrient or inhibited by the absence of that particular substance. Since some of these colors seem to be indicators, they may change with the changes of hydrogen ion concentration in the medium, produced by the metabolism of the organism. Oxidation also seems important in color changes, although it has not been studied carefully. In some cases a considerable pigment is produced in the substratum. The appearance of the mycelium in the colony may be described as velvety, floccose, coremiform, or funiculose.

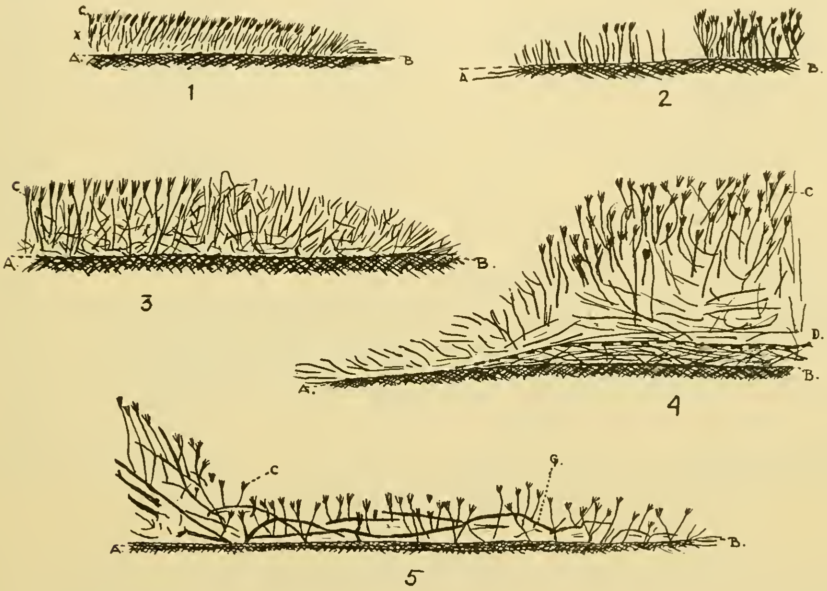

Fig. 90.—Diagrammatic radial sections of colonies. *1*, velvety type; *2*, coremiform or fasciculate type; *3*, *4*, floccose type; *5*, funiculose type; *AB*, surface of substratum; *X*, conidiophores; *C*, conidial heads (×25). (After Thom 1930.)

In the **velvety** type, nearly all the hyphae are submerged in the substratum, and the conidiophores branching from the submerged hyphae rise above the surface and produce the conidial masses. Such colonies in section resemble a field of wheat (Fig. 90, *1*).

In the **floccose** type, a white cottony mass of branching and interlacing hyphae spreads evenly or unevenly over the surface of the nutrient medium. Conidiophores arise from these aerial hyphae, usually beginning in the center and developing toward the margins. Throughout the growing period a sterile margin surrounds the fertile area (Fig. 90, *3*, *4*). In their extremes, these two types are very distinct, but every intermediate gradation exists.

In the **coremiform** type, the colonies consist of a submerged vegetative mycelium and upright columns of hyphae or conidiophores, called coremia, giving the macroscopic appearance of a stalk and conidial head (Fig. 90, *2*). Thom (1930) reports that coremium formation occurs following the development of trailing or ascending ropes of hyphae which anastomose in a characteristic manner, or when the mycelium produces all or part of its conidiophores in clusters or fascicles with or without sterile or partially sterile areas between. These fascicles, developing in a conidial area otherwise velvety, give a rough or uneven appearance to the margin which has sometimes been described as mealy.

The **funiculose** type is characterized by aerial ropes or bundles of several to many hyphae branching and interlacing over the surface, ascending, but rarely if ever vertical. In these species part or all of the fertile hyphae arise as branches from these ropy networks, although usually some simple conidiophores are found (Figs. 90, *5* and *91*).

For most species, correct information as to the relationship between submerged mycelium and conidiophores can be clearly observed only at the margin of the colony. Often a slowly growing colony is much easier to observe than a rapidly growing one. Zonation of surface growth is conspicuous in many species (Munk 1912). Ullscheck offers the hypothesis that zonation appears when colonies grow rapidly, secrete enzymes, and produce by-products of their metabolism in such concentrations that they reduce or suppress growth and conidial formation in such zones. The mycelium growing through these zones into fresh nutrients resumes vigor of growth and reproduction only to be depressed again by the excessive by-products of this heightened activity. The extension of the colony thus gives the appearance of zonation.

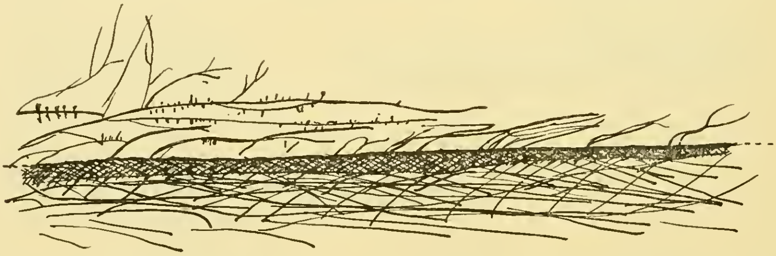

Fig. 91.—Diagrammatic radial section of a colony of *Paecilomyces Varioti* showing loose submerged hyphae, dense mycelial layer at the surface, aerial trailing hyphae and ropes of hyphae bearing penicilli (×25). (After Thom 1930.)

The conidiophores which arise from the mycelium as vertical, aerial hyphae, are highly differentiated. In *Aspergillus* a mycelial cell enlarges, becomes thick-walled, and often variously contorted. From this cell, often called the foot cell, a vertical branch develops, usually midway between the ends. This branch, known as the stalk, usually having thick walls and thin septa, enlarges upward toward the top where it dilates into a pyriform to nearly spherical vesicle. In the *Aspergillus glaucus* group, the septa are thick and the stalk is often referred to as articulate. The thickening of the stalk walls may be smooth, or pitted, or warted. These characteristic markings on the stalk may be of considerable diagnostic value if present but must be carefully observed with high magnifications. The vesicle is partly or wholly covered by a layer of cells radiating from the whole surface or parallel with the long axis of the stalk if covering only the upper portion of the vesicle. These cells, variously called **phialides** (Fig. 92, *1-3*), sterigmata, or basidia, may occur in either one or two layers, differentiated as primary and secondary phialides. These retain a close protoplasmic connection with the vesicle, as may be seen in cases where the surface of the vesicle is thickened and the points of attachment of the phialides appear as pits. The length and diameter and the proportion of these measurements to the diameter of the vesicle, together with their arrangement on the vesicular surface, furnish important

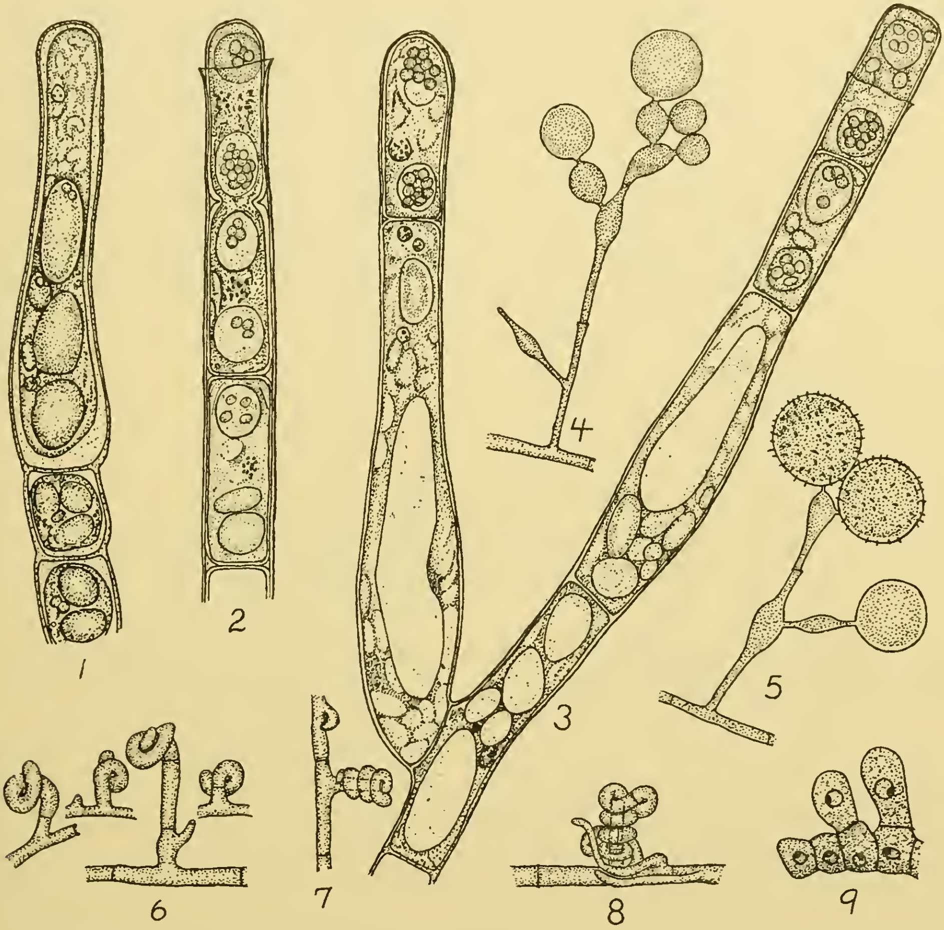

Fig. 92.—*Thielavia basicola.* *1,* young phialide with reserve food materials before the formation of the first conidium; *2,* older stage, typical of conidial production of *Chalara* of the Fungi Imperfecti; *3,* the left branch has formed the wall of the first conidium; the basal cell is again binucleate. The right branch shows the first conidium leaving the sheath. *Thielavia Sepedonium.* *4, 5,* chlamydospores; *6-8,* stages in copulation; *9,* ascogenous hypha with young asci. (After Brierly 1915 and Emmons 1932.)

diagnostic characters (Fig. 93). The phialide narrows at the apex into a thin-walled tube from which all conidia arise. The tube lengthens, mitosis is followed by the formation of a secondary wall around the newly formed conidium within the original wall of the tube. This is followed by rapid growth of the conidium which assumes the size and shape characteristic for the species. The original conidial wall may remain visible as a disjunctor or bridge between the conidia in the chain and may be further emphasized by the deposit of granules, tubercles, or bars of color between the outer or primary wall and the inner, secondary, true conidial wall. In some species the two walls are indistinguishable, although the inner wall may be much thickened, pitted, or grooved.

This method is in sharp contrast with that in *Hormodendrum* and *Cladosporium* where the conidia bud out from the tip of a more or less specialized erect or prostrate, branch and continue to bud from the apex and from various nodes of the branch, producing a dendroid mass with the newer cells at the tips. In the Aspergillaceae, the youngest conidium in the unbranched chain is always the one nearest the phialide.

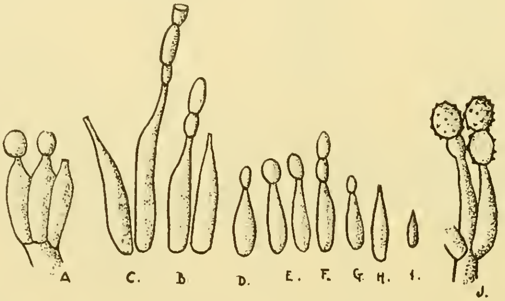

Fig. 93.—Types of phialides. *A*, acute type; *B*, acuminate type; *C*, *Paecilomyces* type with its long tube turned sharply away from the axis of the cell; *D-I*, beaked types; *J*, *Scopulariopsis* type. (After Thom 1930.)

Dangeard reports that the conidia of the *Aspergillus glaucus* group are multinucleate, while those of all the other groups studied by him are uninucleate.

In *Penicillium* (Thom 1930), the conidiophore lacks a differentiated foot cell, and the conidial bearing organs are borne on a complex system of branches known as a **penicillus** instead of upon a vesicle (Fig. 94). If each terminal branchlet with its cluster of phialides and conidial chains seems to stand out separately, the penicillus is called **monoverticillate**. It may be borne upon an irregular system of branches at various levels along a common fertile hypha, or on one of several diverging branchlets from the tip of the main axis. If branching occurs at two levels, either asymmetrically or symmetrically about the center, it is called **biverticillate**. The asymmetric group does not seem to be homogeneous.

The terminal branches of the penicillus are usually very uniform and differentiated from the other branches. They are generally called **metulae** and bear a verticil of phialides on their tips. The shape of the phialide is usually characteristic for species groups. In the biverticillate series, the phialide is proportionally smaller in diameter and longer, narrowing more slowly at the apex to a much smaller tube (perhaps one-third the diameter of the phialide). In *Paecilomyces*, the phialide consists of a broad, short basal tube narrowed to a long neck which is bent at its base from the main axis of the phialide (Fig. 93, *C*). In *Scopulariopsis*, the characteristic form of the phialide is lost and the cell tapers from its base to the diameter of the newly formed conidium at its apex (Fig. 93, *J*). The conidia are cylindric at first and in many species are slow in attaining their spherical or ellipsoid form. In *Gliocladium*, the general branching and shape of the phialides closely resemble that of *Penicillium*, but the spore chain is surrounded by a film of mucilage and rolls up into a ball. Eventually all trace of the chain is lost and conditions are those suggestive of *Cephalosporium* (Fig. 95).

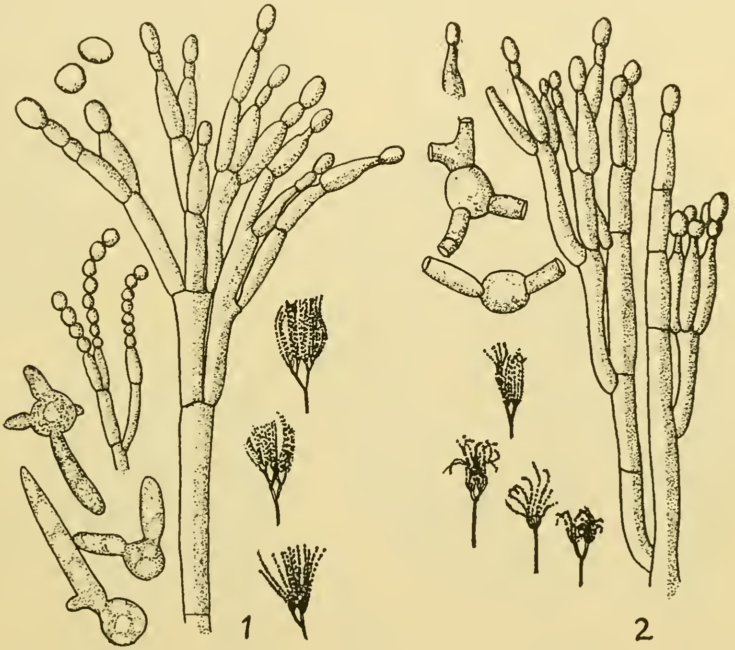

Fig. 94.—Conidial stages. *1, Penicillium Camemberti; 2, P. caseicolum.* (After Thom 1930.)

In *Penicillium "glaucum,"* Guéguen (1899) reports the mycelium and penicillus multinucleate, the phialide typically binucleate, one nucleus remaining in the center of the cell and the other near its tip, while the conidia are uniformly uninucleate.

In *Penicillium Brefeldianum* (B. O. Dodge 1933), a saprophyte from the human alimentary tract, an erect hypha produces long branches, in one of the lower forks of which a coiled mass of hyphae develops the primordium of the perithecium, suggesting a small sclerotium. The sterile surrounding hyphae resemble the pseudoperithecium of the Gymnoascaceae. In this species it is unknown whether sexual organs are produced in this mass, but the system of ascogenous hyphae develops in it (Fig. 96). Very interesting results are expected from further work on this group in progress by Emmons.

Perithecia are frequently formed in *Aspergillus,* very rarely in *Penicillium.* In most of the species so far studied, their appearance is preceded by the formation of sexual organs. They may be arranged in four groups, depending on the reported methods of perithecial development. In the first group, as in *Aspergillus nidulans,* two equal copulatory branches are formed; they coil around each other helically and apparently fuse at the tip (Fig. 97, *1-3*). The

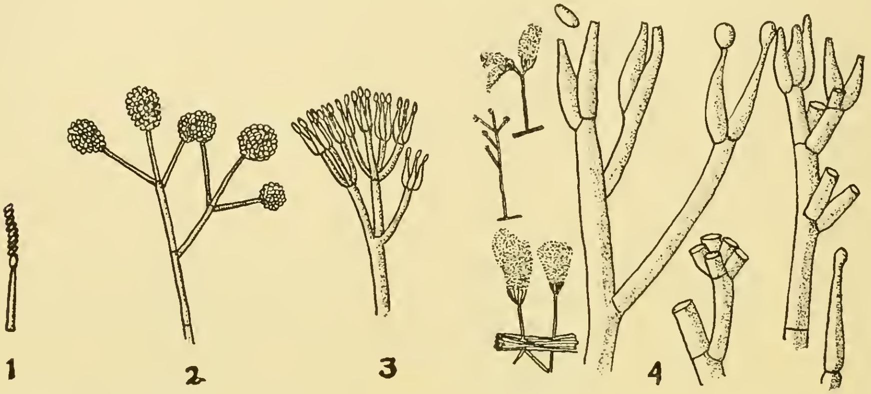

Fig. 95.—*Gliocladium roseum.* *1,* diagram of phialide of the *Clonostachys* type; *2, Acrostalagmus* type; *3, Penicillium* type; *4,* more typical structures, showing various stages in the formation of the penicillus which becomes a gelatinous mass of conidia.

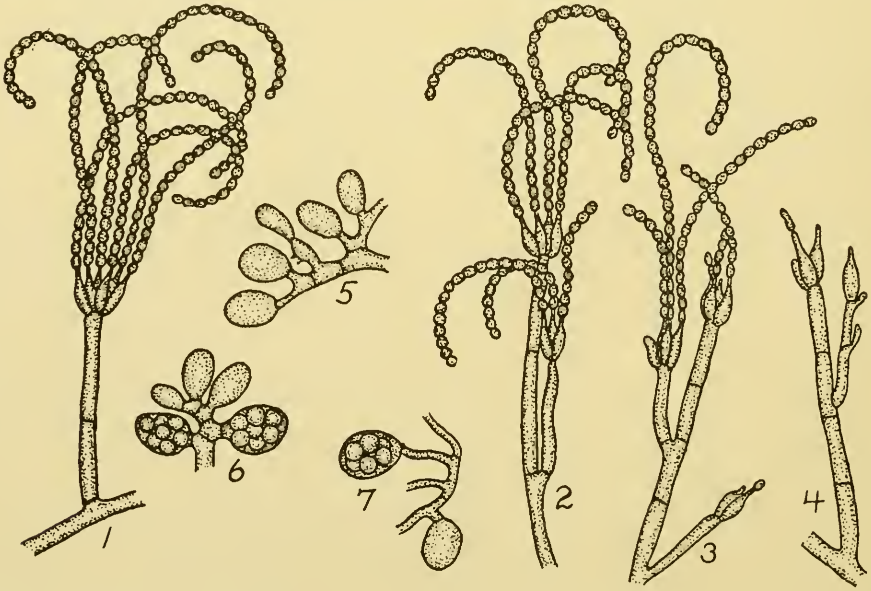

Fig. 96.—*Penicillium Brefeldianum.* *1-4,* development of conidiophores; *5,* growth of asci from ascogenous hyphae. (After Shear.)

contents of one copulatory branch migrate into the other. Both are then surrounded by a dense hyphal knot, which subsequently assumes a plectenchymatous character (Fig. 97, *4-7*). Here copulation is isogamous as in many Endomycetaceae and Gymnoascaceae.

The second group is typified by *Penicillium Wortmanni (P. vermiculatum)*. The hyphae are always uninucleate. The ascogonium appears as a branch of a hypha. Its single nucleus rapidly divides until the cell is 16-nucleate. The antheridium, a slender branch arising on a different hypha, coils several times about the ascogonium and abjoints a uninucleate apical cell which swells slightly (Fig. 98, *1*). Meanwhile the number of nuclei in the ascogonium has reached about 64. The apical cell of the antheridium fuses with the ascogonium (Fig. 98, *3*). Dangeard (1907) was unable to see nuclear migration and concluded that the male nucleus remains in the antheridium and degenerates.

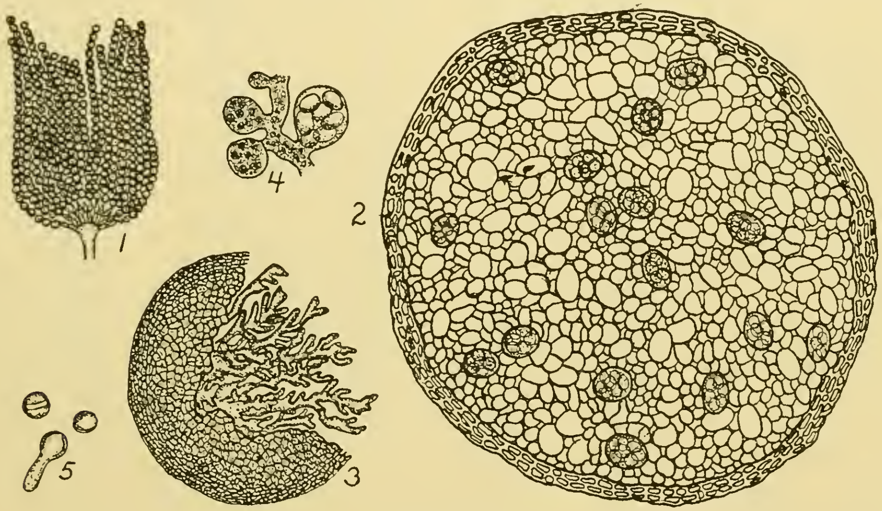

Fig. 97.—*Aspergillus nidulans.* *1,* conidiophore showing primary and secondary phialides; *2,* section of perithecium, showing asci and perithecial wall; *3,* perithecium ruptured; *4,* young asci; *5,* germinating ascospores (*1* ×230; *2* ×170; *3* ×85; *4* ×400). (After Eidam 1883.)

The ascogonium then divides into numerous binucleate cells, each of which may develop ascogenous hyphae (Fig. 98, *4-7*). Here we have a morphologic differentiation of antheridium and ascogonium; the appearance of the antheridium is retarded and if Dangeard correctly observed the normal development, its single nucleus has become functionless.

The third group may be typified by *Apergillus herbariorum, A. repens* and *A. fumigatoides.* The ascogonium develops as a hyphal branch, and coils in a helix with a continually shortening radius. It is divided into two or more multinucleate cells of which the terminal is generally the longest and contains about 20 nuclei. Shortly before or after the septation of the ascogonium, the antheridium appears and climbs along the ascogonial helix. Many times it is formed independently of the ascogonium on another hypha; often it grows from two or three slender branches at the base, more rarely from a higher coil of the ascogonium. Occasionally it may arise even inside the helix and thus appear much like *Aphanoascus* and *Ctenomyces*. Fusion of ascogonium and antheridium has not yet been demonstrated. The antheridium appears to be vestigial; the nuclei often degenerate before it reaches its full length, or it ceases its growth halfway and does not reach the tips of the ascogonial spiral; or it may be entirely absent. In any case, the ascogonium develops parthenogenetically; it divides into binucleate cells, some of which grow to ramose ascogenous hyphae.

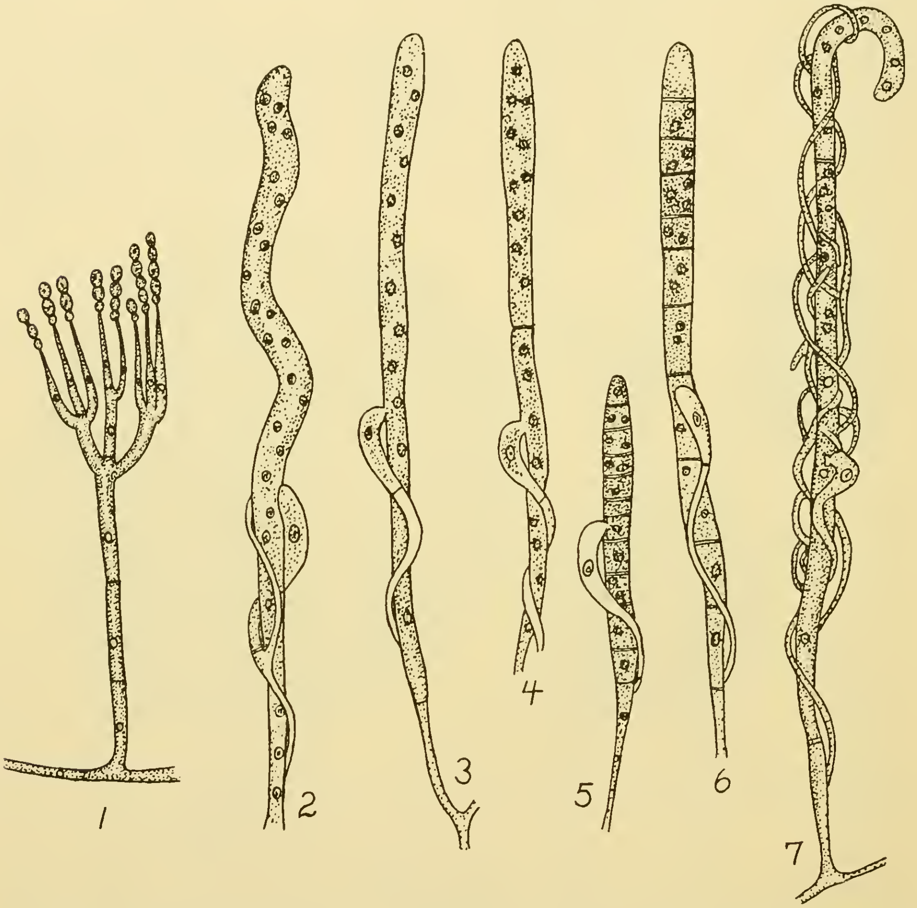

Fig. 98.—*Penicillium Wortmanni.* *1,* conidiophore and conidia; *2,* the multinucleate ascogonium and young antheridium; *3,* the antheridium is in open communication with the ascogonium, but the male nucleus remains in the antheridium; *4-7,* the ascogonium surrounded by sterile hyphae is divided into binucleate cells which are beginning to develop ascogenous hyphae (×900). (After Dangeard 1907.)

In the fourth group, comprising *Aspergillus flavus* and *A. Fischeri* (*A. fumigatus* Auct. non Fres.), the antheridium is no longer formed (Dangeard

1907; Domaradsky 1908). The helical ascogonium divides into binucleate cells which develop ascogenous hyphae.

In *Microascus trigonosporus* (Emmons & B. O. Dodge 1931) the conidial stage belongs in *Scopulariopsis.* The ascocarp originates from a coiled ascogonium. Hyphae, which perhaps are antheridia, may be present or absent and in any case are probably no longer functional. The ascogonium becomes surrounded by the hyphae of the developing perithecial wall and is carried up until it occupies a position above the center of the maturing perithecium instead of at its base as in most genera. The ascogenous hyphae, therefore, grow downward as well as radially from the ascogonium. The asci arise as lateral or terminal branches of the ascogenous hyphae. Crozier formation has not been noted in this species. Eventually the asci deliquesce and the spores are embedded in a gelified mass which is extruded from the mouth of the perithecium. As the name implies, the spores are more or less tetrahedral in this species. In *M. intermedius,* from decaying strawberry roots, development is similar, although the conidial stage is unknown. Occasionally the tips of the ascogenous hyphae are curved, but whether these perform the functions of croziers as reported by Fraser [Gwynne-Vaughan] & Chambers (1907) for *Aspergillus herbariorum* is unknown. Occasionally two or three ascogonia are included in the same developing perithecium. In such a case, each group of asci develops independently and may produce its own ostiole.

In *Thielavia terricola,* apparently there is no trace of an antheridium, and the ascogenous hyphae develop directly from the ascogonium. The asci develop from croziers, with typical fusion of the dicaryon of the penultimate cell as is usual in the higher Ascomycetes. The ascogonium is located near the middle of the perithecium, the radiating ascogenous hyphae are short. No central cavity is formed but, as the asci develop, they destroy the tissue of the interior of the perithecium. *Thielavia Sepedonium,* originally isolated as a saprophyte from normal skin of the foot, follows the general type of *Microascus trigonosporus.* The conidial stage belongs in the genus *Sepedonium* (Fig. 92, *4, 5*) quite distinct from the usual type found in the Aspergillaceae. No antheridium is known (Fig. 92, *6-8*); the perithecium lacks an ostiole. The ascogenous hyphae are uninucleate except for the terminal cell, which is usually binucleate (Fig. 92, *9*). The ascus cell has only a single nucleus, the other member of the dicaryon remaining behind in the supporting cell in the ascogenous hypha. Apparently no nuclear fusion occurs during the life cycle. The usual nuclear divisions take place in the ascus, the chromosome number being constantly four. A somewhat similar development has been reported in *Penicillium Brefeldianum* by B. O. Dodge (1933).

Apparently sexuality has gradually degenerated with retardation and ultimate elimination of the antheridium until in *Thielavia Sepedonium* and *Penicillium Brefeldianum* there are no traces of an antheridium, no nuclear fusions or reduction divisions in the life cycle.

In most of the Aspergillaceae, perithecial formation is quite uniform. In *Aspergillus herbariorum, A. Fischeri, Penicillium Wortmanni, P. javanicum, P.*

Brefeldianum, and *Scopulariopsis albonigrescens (Acaulium albonigrescens),* the ascogenous hyphae divide without resting periods into binucleate cells which, with the fusion of the nuclei, except in *P. javanicum* and *P. Brefeldianum,* develop into asci. The ascogenous hyphae gradually digest the inner layers of pseudoparenchyma of the fructification and thus provide the nourishment for the developing ascospores. The mature perithecia consist of a more or less solid pseudoparenchymatous sheath filled with a brownish spore powder. They generally open at the top by disintegration of the upper portion of the perithecial wall. In *Aspergillus nidulans,* the fructifications arise not on the mycelial mat but in special bladder-like sheaths. These sheaths are formed by the cessation of branching of the hyphae next the mycelial covering. The end cells of the ultimate branches swell and thicken their membranes.

The ascospore of *Aspergillus,* by a secondary thickening of its cell wall, develops as two symmetrical valves, suggesting the arrangement found in the valve of a bivalve mollusk. The ripe ascospores are commonly shaped as a double convex lens with the valves more or less closely in contact at the edges. A series of variations is possible as shown in Fig. 99. If the exospore is in close contact at all points and the valves are brought together, we find the condition shown in Fig. 99, *1;* a loose fold of exospore at the line of contact of the valves gives Fig. 99, *2,* as in *Aspergillus pseudonidulans;* if the valves remain slightly separated and a fold of exospore develops at each margin we find the condition shown in Fig. 99, *3, 4,* as in the *A. herbariorum* group; if the exospore is further thrown into folds or wrinkles on the surface of the valves, we find the spores of *A. echinulatus, A. nidulans,* and *A. Fischeri* (Fig. 99, *5*); if the folds are reduced or absent, we see the spores of the *A. repens* series (Fig. 99, *6, 7*). At germination the ascospore swells, the valves first separate along one edge, then after complete separation remain attached to the opposite sides of the spore for some time. In *Penicillium Brefeldianum* the valvelike nature of the spore wall is seen only in germination.

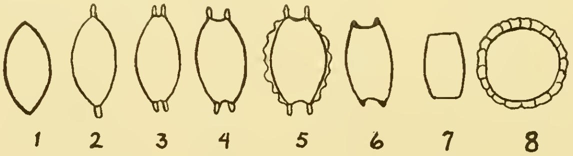

Fig. 99.—The ascospores of *Aspergillus.* *1-7,* optical section of the ascospores viewed from the edge (girdle view); *8,* same, viewed from the top (valve view); *1,* spore without frill or furrow; *2,* spore with single frill at union of the valves in *A. pseudonidulans; 3,* spore with valves slightly separated, with race of furrow and two frills; *4,* valves separate, furrow evident and frills broad as in *A. herbariorum; 5,* furrow and frills evident with exospore thrown into folds on the convex faces of the valves, as in *A. nidulans* and *A. Fischeri; 6,* valves further separated, frills reduced to traces, and furrow scarcely visible; *7,* neither frill nor furrow visibly present, but valves separated as in *A. repens.*

Sclerotia, hard masses of mycelium with characteristic surface markings and colors, occur in several groups of species in *Aspergillus* and *Penicillium.* These consist largely of pseudoparenchyma and have probably often been mistaken for perithecia.

The Aspergillaceae are largely saprophytes, although certain genera are widely used in fermentations. *Monascus* is used to color rice red in Chinese cookery; *Aspergillus* is used in the making of soy bean sauces and in fermentations; *Penicillium* is important in curing cheese. The *Aspergilli* are important as saprophytes and facultative parasites about the ear and the respiratory tract of mammals, occasionally in other situations. *Scopulariopsis* often attacks the nails.

Key to Genera

- Perithecium flask-shaped, beaked or papillate. *Microascus.*
- Perithecium with hairlike appendages, peridium compact.
  - Appendages straight or nearly so, forming a hairy felt. *Cephalotheca.*
  - Appendages of apically coiled hairs. *Magnusia.*
- Perithecium without appendages; peridium membranous or fleshy; perithecium often absent.
  - Conidia borne directly on the mycelium.
    - Hypnospores in chains. *Thielavia.*
    - Hypnospores solitary. *Rostrella.*
  - Conidia borne in chains; from specialized cells called phialides.
    - Basal cell of conidiophore highly specialized, upper cell a swollen vesicle bearing one or two series of phialides. *Aspergillus.*
    - Basal cell not differentiated, upper cell not swollen.
      - Conidiophores occurring singly or in small groups; perithecia usually absent, never stalked.
        - Phialides flask-shaped, straight, axis usually parallel to that of the metulae upon which they are borne.
          - Chains of conidia not held together by secretion of a gel. *Penicillium.*
          - Chains of conidia held together by secretion of a common gel, in some species chains disappear, leaving only an irregular arrangement in the gel. *Gliocladium.*
        - Phialides flask-shaped, with long tapering neck of the flask at an angle to the main axis of the phialide. *Paecilomyces.*
        - Phialides not flask-shaped but tapering gradually from base to apex. *Scopulariopsis.*
  - Conidia not in chains but adhering in subspheric masses. *Allescheria.*

ASPERGILLUS

Aspergillus Micheli, Nova plantarum genera 212. *Pl. 91,* 1729, Link, Observationes in ordines plantarum naturales. Mag. Ges. Naturf. Freunde Berlin **3**: 16, 17, 1809.

The type species is *Aspergillus glaucus* Link.

Vegetative mycelium consisting of septate branching hyphae, hyaline or bright colored, or, in few forms, slowly brown in localized submerged areas or producing brown sclerotia; conidial apparatus developed as stalks and heads from specialized, enlarged, thick-walled hyphal cells (foot cells), producing stalks as branches approximately perpendicular to the long axis of the foot cells; stalks not septate or septate, usually enlarging upward and broadening into ellipsoid, hemispheric, or globose fertile vesicles bearing phialides either parallel and clustered in terminal columns or radiating from the entire surface; phialides in either one or two series; conidia varying greatly in color, shape, and markings, successively cut off from the tips of the sterigmata by septa and forming unbranched chains arranged in radiate heads or packed into columnar (calyptrate) masses; perithecia found in some species, unknown in others, cleistocarpous, thin-walled, producing asci and ascospores within a few weeks; sclerotia regularly found in some strains, occasionally found in other strains and not found in other closely related strains, mostly spherical or subspheric, commonly composed of thick-walled cells which appear to be filled with stored material.

The species of this genus are predominantly saprophytic, but certain species are quite regularly pathogenic. Perhaps the organ attacked most commonly is the lung, where symptoms clinically resembling those of pulmonary tuberculosis are produced, but tubercles are not produced in the lungs and the conidia are abundant in the sputum, while no trace of *Mycobacterium tuberculosis* is found. Most of these cases have cleared up on treatment with potassium iodide. They seem especially abundant in regions of high humidity.

The natives among the Watusi make use of the pathogenicity of some species of *Aspergillus* in an interesting way, according to Mattlet (1924). When they wish to wreak vengeance on some one, they exhume a corpse of a person recently dead of a pneumomycosis, remove the lungs, desiccate them, and mix the powder in a banana beer. Evidently the *Aspergillus* is not killed by this process and the recipient wastes away with aspergillosis, without suspecting the cause.

The species attacking the lungs have been reported to attack other internal organs, especially the kidneys, of experimental animals. The older literature is very well summarized by Renon (1897), Lang & Grubauer (1923), and Perin (1925).

The species centering around *A. nidulans* have been frequently found in mycetomas, usually producing the black grain type not essentially different clinically from lesions produced by *Madurella* (see p. 680). Finally, there are many saprophytes centering around *A. niger* but including representatives of most of the other groups, which are found in the external auditory conduit, more rarely in the nasal sinus, or other situations. These species, probably primarily saprophytes, have found favorable conditions for growth in the cerumen and, under ordinary conditions, are harmless beyond causing mechanical irritation. A few cases have been reported where virulence seems greater, and some damage was done to the surrounding tissues. A few species have been reported as attacking the nails. Ballagi & Laubal (1933) have shown that certain species are capable of producing crusts and scales in cutaneous inoculation and abscesses in subcutaneous inoculation in the guinea pig.

Key to Pathogenic Species

Conidiophore walls thick, pitted, commonly reported as rough, asperulate or spinulose.

Colonies yellow to brick red, conidia small, 3-4μ; conidiophores yellow, 6-10μ in diameter; heads 70-80μ; vesicle subspheric, 20-30μ in diameter; primary phialides up to 30μ long, 4-5μ in diameter below, 10-12μ at apex, secondary phialides, 6-10 × 2-3μ. *A. Greconis.*

Colonies some shade of green or yellow green on favorable media; conidiophores arising from substratum; phialides partly in one series, partly in two in the larger heads; no sclerotia.

Very inadequately described; from the human ear. *A. flavescens.*

Conidiophores up to 4 mm. long, from human ear. *A. Siebenmanni.*

Colonies greenish yellow in age; conidia ellipsoid, green, 2.3-3.1μ. *A. diplocystis.*

Colonies yellow, greenish in age with heavy masses of aerial mycelium, conidia spherical, 6.4μ. *A. luteus.*

Colonies at first orange yellow, then deep brown; conidia pyriform to spherical, 5.5-6μ, roughened with rather coarse bars of brown coloring matter; conidiophores thick-walled with pitting inconspicuous or partially suppressed. *A. Tamarii.*

Colonies cinnamon or chocolate, conidia 1-2μ. *A. cinnamominus.*

Conidiophore walls not pitted or roughened.

Conidial heads black or brown, never greenish.

Conidia thin-walled, smooth or delicately spinulose, never pitted or roughened, with tubercles or bars of coloring matter.

Phialides in one series, conidia brown, 3-5μ.

Heads brown, phialides 6μ. *A. Gratioti.*

Heads olivaceous to subfuscous, phialides up to 20μ. *A. subfuscus.*

Phialides in two series.

Heads cinnamon to chocolate, chains of conidia radiating. *A. cinnamominus.*

Heads ochraceous, chains of conidia in columns. *A. Hortai.*

Conidia roughened by tubercles or bars of color, phialides in two series.

Primary phialides about 50μ long. *A. Phoenicis.*

Primary phialides 20-30μ long. *A. niger.*

Primary phialides about 12μ long. *A. Macfiei.*

Conidial heads some shade of green.

Phialides in one series.

Conidia more than 4μ in long axis, ellipsoid to pyriform (spherical in *A. Amstelodami*), pitted or rough.

Perithecia present, yellow to orange in sucrose media.

Ascospores with furrow but no ridges, 10 × 4.7μ; perithecia 200-220μ; conidia 9-12μ. *A. Mencieri.*

Ascospores with furrow, 6 × 4-5μ; perithecia 80-120μ, conidia 5-8μ. *A. ruber.*

Ascospores 5.5 × 3.7μ; perithecia 30-100μ; conidia 3.4-5.6μ. *A. montevidensis.*

Ascospores 4.7 × 3.7μ.

With distinct furrow, conidia 2.5-4.5μ, spherical, echinulate. *A. Amstelodami.*

Without furrow, conidia 4.7 × 7.6μ, saprophyte reported from human ear. *A. repens.*

Perithecia usually absent (at least not described); conidia 4-6 × 3.5μ.
A. Fontoynonti.
Conidia less than 4μ in diameter, spherical.
Perithecia present, ascospores with furrow.
Conidiophores up to 1,000μ, heads radiate, conidia 3-4μ, ascospores 6 × 8μ.
A. malignus.
Conidiophores 150-310μ, conidia ovoid, 2-3 × 2μ, ascospore rough, 3-3.5μ.
A. fumigatoides.
Perithecia absent.
Mycelium floccose, stalks 400-600μ long, conidia 2.8-3.6μ.
Pathogenic to fowls. *A. bronchialis.*
Pathogenic to rabbits. *A. viridogriseus.*
Mycelium velvety, conidiophores 170-350μ, conidia 2.5-3μ.
A. fumigatus.
Phialides in two series.
Conidial heads radiating, green; mycelium often red, conidia 3-3.5μ, spinulose.
Colony green blue, becoming orange or tawny.
A. tunetanus.
Colony vermilion. *A. tropicalis* (p. 639).
Colony greenish, sterile mycelium white. *A. Brodeni.*
Colony darker green, with radial furrows. var. *Vancampenhouti.*
Colony grayish blue, interrupted by straw yellow areas formed by cespitose sclerotia. *A. cyaneus.*
Conidial heads in columns, green; mycelium colorless, perithecia deeply enveloped in mycelium with swollen, very thick-walled parietal cells; walls pink to deep red or almost black, conidiophores colored, ascospores purple.
In human ear. *A. nidulans.*
Producing mycetoma. var. *Nicollei.*
In lungs of ass. var. *Cesarii.*
On nails.
Phialides 5 × 3μ, conidia 3μ. *A. unguis.*
Phialides 10-15 × 5μ, conidia 5μ. *A. Jeanselmei.*

Aspergillus Greconis, Dodge, n. nom.

Sterigmatocystis aurea Greco, Origines des Tumeurs . . . 671-694, *Figs. 418-428*, 1916.

Isolated from pustules and abscesses, perhaps only a contaminant.

Stalks 6-10μ in diameter; walls thick, yellow; heads golden yellow to brick red(?), 70-80μ in diameter; vesicle 20-30μ in diameter. Primary phialides up to 30 × 4-5μ in diameter at base, 10-12μ at apex. Secondary phialides 8-10 × 2-3μ, conidia nearly spherical, 3-4μ in diameter.

This species belongs in the *A. ochraceus* group but dimensions are all smaller. *Aspergillus ochraceus* has been reported from a case of otitis media by Bellucci, but his description is too vague to be sure of the identity.

Aspergillus Siebenmanni Lucet & Costantin, Ann. Sci. Bot. IX **2**: 162, 1905.

Aspergillus flavus Siebenmann, Zeitschr. Ohrenheilk. **12**: 124-161, 1883 non al.

Isolated from human ear. This species belongs in the *A. flavus* group, but has been too briefly described to identify with certainty. Conidiophores up to 4 mm. long.

Aspergillus flavescens Wreden, C. R. Acad. Sci. **65**: 368, 1867; St. Petersburg. Med. Zeits. **13**: 133, 1867, not cultivated.

Produces mat of mycelium covering the eardrum, which may be peeled off with care. Best destroyed by $Ca(OCl)_2$ or dilute potassium arsenite.

Has botanical characters of *A. glaucus* Link when grown on slices of citron or sweet orange. Differs from *A. fumigatus* by yellow spores.

The organisms mentioned by Lichtheim (1882) and others are supposed to be synonyms of *A. flavus* or *A. nidulans.*

Aspergillus diplocystis (Sartory, Sartory, Hufschmitt & Meyer) Dodge, n. comb.

Eurotium diplocyste A. Sartory, R. Sartory, Hufschmitt & Meyer, C. R. Soc. Biol. **104**: 881-883, 1930.

Cause of onychomycosis with inflammation and suppuration, first on thumb, then on great toe. Mycelium and chlamydospores demonstrated in nail.

Conidiophores erect, 50-100μ high, 3.1-3.7μ in diameter, membrane thick, hyaline. Phialides confined to a portion of head, 5-6.25 × 1.5-2.5μ. Secondary phialides small, conidia spherical, 2.25-3.1μ in diameter, slightly ellipsoid, green (*tendre* to *cendré*), phialides abortive and proliferous. Perithecia canary yellow; asci 4-6 × 5-7μ, containing 8 ascospores which are ovoid, with a furrow and two crests, 1.5-2.5 × 1.8-3.1μ.

Colonies greenish yellow, becoming yellow from perithecia.

Aspergillus luteus (Tieghem) Dodge, n. comb.

Sterigmatocystis lutea Tieghem, Bull. Soc. Bot. France **24**: 103, 1877; Bainier, Bull. Soc. Bot. France **27**: 30, 1880; Sartory & Jourdre, C. R. Acad. Sci. **146**: 548, 549, 1908.

Caused death of rabbit on intravenous injection. Organism recovered from kidneys and liver.

Mycelium white, yellow, then turning green, erect conidiophores 300-800μ high, with heads 12-30μ in diameter. Primary phialides 10 × 5-6μ, with 2-4-6 secondary phialides, 9 × 4μ in diameter. Conidia at first yellow then glaucous, spherical, smooth, 3.5μ in diameter. On gelatin, agar or broth, growth becomes aspergilloid, optimum temperature 35° C.

On agar, growth slow, white, yellow, then green. On potato, acid or neutral, whitish hyphae appear at first, yellow on the second day, turn green by the fifth, and the colony becomes folded. On carrot, growth is similar, but mycelium remains flat, chlorine yellow on the seventh day, grass green on the eleventh. On Raulin's medium, a mat, which becomes green and folded on the second day. On neutral Raulin's medium, growth slower. In broth, conidia slightly verrucose. Liquefaction of gelatin begins in 4 days, complete in one month—Sartory & Jourdre.

For discussion of synonymy, and identities, see Thom & Church, *Aspergilli,* p. 207, 1926.

Aspergillus atropurpureus A. Zimmermann, Centralbl. Bakt. II, **8**: 218, 1902.

Sterigmatocystis fusca Bainier, Bull. Soc. Bot. France **27**: 29, 1880, non *Aspergillus fuscus* Bonorden.

A saprophyte. The reports of pathogenicity of *S. fusca* by Sartory & Jourdre (1908) should be referred to *Aspergillus Tamarii.*

Aspergillus Tamarii Kita, Centralbl. Bakt. II, **37**: 433-452, 1913.

A saprophyte. Found pathogenic for rabbits on inoculation by Sartory & Jourdre (1908).

Sartory & Jourdre describe their culture as follows: Conidiophores 800-1,200μ high; vesicle 40-60μ, covered by phialides 18-26 × 10μ with 1-4 clavate secondary phialides; conidia spherical, echinulate, yellow, 5.5-6μ.

Growth on agar is slow, the surface becoming covered in 15 days. Colony on potato is fertile in 2 days but sterile in parts, tawny with snow-white margins 3-4 mm. broad. By the fiftieth day, surface is covered with a greenish orange colony. (178, *Code des Couleurs.*) Growth on acid potato and carrot is the same. On coagulated egg albumen, growth weaker, chocolate brown. On broth, growth also slow, filamentous flat thallus shows a mixture of normal and aspergilloid forms. On Raulin's normal medium at 22° C., colony is fertile on the second day, smooth, yellow olive at first (157, *Code des Couleurs*), orange next the liquid by the seventh day. In Raulin's neutral medium, growth similar but less vigorous. Grows on Raulin's sugar media in order as follows: maltose>sucrose>glucose>lactose. On lactose, filaments have a chocolate brown color. Raulin's neutral gelatin becomes clear, colorless liquid in 6 days. Broth gelatin is similar, with aspergilloid forms common in growth. Egg albumen not liquefied.

Thom and Church describe this organism as follows:

''Colonies on Czapek's solution agar with cane sugar spreading broadly, with vegetative hyphae mostly submerged, with fruiting areas at first colorless, then passing through orange yellow shades to brown in old colonies (variously Isabella color, light brownish olive, buffy citrine, medal bronze or raw umber. Ridgway, column 19, on Plates XXX, XVI, IV and column 17, Plate III), not showing true green; reverse uncolored or occasionally pinkish; stalks arising from submerged hyphae, up to 1 to 2 mm. in length, becoming several millimeters in length upon corn or other concentrated media, 10-20μ in diameter, increasing in diameter towards the apex and passing rather abruptly into vesicles with walls rather thick, 1 to 2μ, becoming abruptly thinner at the base of the vesicle, pitted more prominently in upper than in lower half (often appearing as rough or echinulate with low magnifications) and frequently showing irregular thickenings within; vesicles 25-50μ in diameter, with fairly thin walls which frequently crush in mounts; heads varying greatly in size in the same fruiting area, from more or less columnar to nearly but not completely spherical and up to 350μ in diameter, with radiating chains and columns of conidia; phialides, one series in small heads, two series in large heads, primary commonly 7 to 10 by 3 to 4μ, becoming 20 to 35μ long in gigantic heads upon corn, secondary 7 to 10 by 3μ; conidia more or less pyriform toward globose, tuberculate especially at the distal end in the chain, 5, 6, occasionally up to 8μ in diameter, rough from prominent masses and bars of orange yellow coloring matter deposited under the loose outer wall upon the firm inner wall. Sclerotia occasionally produced, usually purple or reddish purple, globose to pyriform with apex white."

Aspergillus Gratioti Sartory, C. R. Acad. Sci. **170**: 523, 524, 1920.

Found on the nails of a Chinese workman in France.

Pieces of the nail, on being treated with 40% KOH, show sometimes septate mycelium, sometimes unsegmented. Chlamydospores 20-40μ in diameter, sometimes terminal, frequently intercalary. Conidia free, 3.5-4μ in diameter. In culture, hyphae grayish, then brown and black, 0.6-1.5μ in diameter, much branched. Fertile hyphae short with delicate walls about 4-5μ in diameter, vesicle spherical, 8-20μ in greatest diameter. Phialides elliptic, 6μ long, very close-packed. Conidia globose, 3-3.5μ in diameter, brown. Sclerotia and perithecia not seen.

On Raulin's maltose agar, colony is moist and grayish, becoming visible on the fifth day, black by the tenth. Colony elevated, irregularly rugose in the center, less so at the margin. Conidiophores in concentric circles. Seen from below, culture appears brown with the substrate also colored. No marked odor. Growth on glucose agar the same. Growth the same, but less pronounced on other media; e.g., potato, potato glycerol, carrot, Sabouraud's nutrient gelatin, a variety of Raulin's sugar solutions (sucrose, glucose, lactose, maltose), and milk. No growth on coagulated beef serum, egg albumen, or acid potato. Milk coagulated on the twelfth day, curd digested. Gelatin liquefied on the fifth day.

Aspergillus subfuscus Johan-Olsen [Sopp] & Gade, Nord. Med. Ark. **18**: 9:14-16, 1886; Johan-Olsen [Sopp], Bot. Jahresber. **14**: 476, 1886; Meddel. Naturhist. Foren. Kristiania, 1885.

Sterigmatocystis subfusca, Saccardo, Syll. Fung. **10**: 526, 1892; Sartory & Jourdre, C. R. Soc. Biol. **64**: 928, 1908.

Pathogenic when injected into rabbits.

Mycelium snow-white, coarsely articulate, sparingly branched. Curious raylike involution forms present, conidiophore 18-20μ from base to vesicle, vesicle 30-90μ, head, including chains of conidia, 90-200μ in diameter. Phialides 20μ long, conidia 3-3.5μ in diameter, olive brown, spherical, smooth. At optimum temperature of 36-38° C., conidia appear in 30-36 hours, more slowly at lower temperatures. No perithecia or sclerotia reported.

Organism grows best on bread medium (10 c.c. finely crumbed bread, 125 c.c. H_2O, and 2 drops lemon juice), also grows on agars and gelatin. Giant cultures, grown at room temperature, are olive brown in color. At 37° C., color deeper, then greener. Mycelium white, quite smooth then raised above the substrate. Colony lightest at the edges, deepest in color at center.

Aspergillus cinnamominus (Weiss) Dodge, n. comb.

Sterigmatocystis cinnamominus Weiss, Ann. Parasitol. Hum. Comp. **8**: 189-193, *5 figs.*, 1930.

Isolated from a case of pityriasis versicolor flava of brown spots with discrete depigmentation and a few small vesicles at the borders. Reinoculation into human skin gave typical lesion. On rabbit, scarification produced epidermic lesions, while subcutaneous inoculation gave rise to subcutaneous gummata, with the picture of generalized pseudotuberculosis revealed at autopsy.

Hyphae septate and branched; conidiophores simple, 5μ in diameter, vesicle 12 × 9μ. Primary phialides cylindric, 4μ long, bearing 2-3, sometimes 4 secondary phialides, 5-6μ long. Conidia spherical, 1-2μ in diameter, brown. Other spores, borne laterally on short branches (phialides?), 3-4μ. Chlamydospores occasional. Under some conditions, only monstrous phialides are formed, with a "pleomorphic" mycelium resulting.

Aspergillus Hortai (Langeron) Dodge, n. comb.

Sterigmatocystis Hortai Langeron, Bull. Soc. Path. Exot. **15**: 383, 384, *Fig. 1,* 1922.

Found in a case of otomycosis in Brazil. Mackinnon (1932) refers this species to *A. terreus* Thom.

Conidiophore appears empty of protoplasm while neighboring cells appear full. Vesicle 5-10μ in diameter, primary and secondary phialides 5 × 1.5μ, scarcely covering upper half of vesicle. Primary phialides give rise to two, occasionally three, secondary phialides. Conidia smooth, 2.5μ in diameter, in long chains.

Aspergillus Phoenicis (Corda) Thom & Church, Aspergilli 175, 1926.

Ustilago Phoenicis Corda, Icon. Fung. **4**: 9, *Pl. 3, Fig. 26,* 1840.

Sterigmatocystis Phoenicis Patouillard & Delacroix, Bull. Soc. Myc. France **7**: 119, *Pl. 9,* 1891.

Sterigmatocystis antacustica Cramer, Vierteljahrschr. Naturf. Ges Zürich **4**: 325-337, *Pl. 2,* 1859.

Saprophyte, originally isolated from dates. *S. antacustica* Cramer isolated from external ear of man. *Aspergillus niger* Risel (1906) non al. from lungs apparently belongs here.

Vesicles 45μ in diameter; primary phialides 20-50μ long, several secondary phialides to a primary phialide; conidia 2.5-3.5μ.

This species has often been confused with *Aspergillus niger* Tieghem by subsequent writers, but differs in the much longer primary phialides.

It is probable that *Aspergillus nigricans* Wreden, C. R. Acad. Sci. Paris **65**: 368-370, 1867, belongs here, but it was too briefly described to place definitely. Apparently it was not cultivated.

Aspergillus niger Tieghem, Ann. Sci. Nat. Bot. V, **8**: 240, 1867.

Sterigmatocystis niger Tieghem, Bull. Soc. Bot. France **24**: 102, 103, 1877.

This species is predominantly saprophytic but occasionally parasitic, especially in the human ear. Unless pathogenicity is clearly proved, reference to this organism should be regarded with suspicion, as it is widespread and common. Thom characterizes the species group as follows:

"Colonies rapidly growing, with abundant submerged mycelium, hyaline, aerial hyphae usually scanty; conidiophores rising directly from the substratum, hyaline or yellow to brown near the vesicle, smooth, wall thick, without pits, but frequently uneven on the inner surface, splitting lengthwise into strips when broken, not septate or with occasional thin septa, varying greatly in length on different media; conidial heads deep brown to black, spherical, radiate; vesicles spherical or subspheric, thick-walled, commonly 20-50μ in diameter, hyaline or yellow brown; phialides usually in two series, the primary covering the vesicle, 20-30μ in length; secondary phialides 6-10 × 2-3μ, brown to black; conidia spherical, thin-walled, smooth with diffuse brown or fuscous color then rough or spinulose from coloring matter deposited as tubercles or bars between the outer and inner walls, 2.5-4μ in diameter."

Aspergillus giganteus (Mattlet) Dodge, n. comb.

Sterigmatocystis giganteus Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 31, 32, 1926.

Sterigmatocystis cas V Mattlet, Ann. Soc. Belge Méd. Trop. **4**: 167-176, *3 figs.*, 1924.

Along with this species a *Parasaccharomyces irritans* was isolated from a case of severe bronchomycosis in the Belgian Congo. Animal inoculations not reported.

Colony yellow saffron at first, then becoming black from the conidia. Mycelium variable, 1.5-6μ in diameter, with dark granules; conidiophore hyaline 12-13μ in diameter, 800-1,000μ long; vesicle 50μ in diameter, about 50 phialides per great circle, covering the whole vesicle; primary phialides about 30μ long, rarely 2-celled, bearing 3-4 secondary phialides about 10μ long, heavily pigmented; conidia in chains, 3μ in diameter, echinulate, black, thick-walled, finally 4-5μ in diameter. Optimum temperature 37° C., growth slow at 21°-23° C.

There is little to distinguish this species from the preceding.

Aspergillus Macfiei Dodge, n. sp.

Sterigmatocystis sp. Macfie, Ann. Trop. Med. Parasitol. **15**: 279-281, 1921.

Isolated from a case of otomycosis in the ear of a European. Caused irritation but no serious damage or deafness. Nonpathogenic in scarified ear of pouched rat (*Cricetomys gambianus*), sheep, or monkey (*Cercopithecus patas*). No effect on intraperitoneal injection in rat.

Hyphae hyaline, conidiophores about 1 mm. long, 14μ in diameter, white, then darkening. Vesicle slightly broader than long, 40 × 37μ, almost completely covered by phialides. Primary phialides 12μ long (average of ten), secondary phialides 8μ long (average of ten). Conidia dark brown, spherical, 4-5.2μ in diameter, average 4.5μ.

On Sabouraud maltose agar, growth is rapid and spreading, yellowish white and feltlike, then fluffy as conidiophores are produced. These are brown to black. On glucose agar at 28° C., there is a white, puckered, and wrinkled surface growth in 24 hours. Then yellow, wrinkled, feltlike, darker with conidiophores beginning. Growth more rapid at 37° C. Growth on potato rapid and abundant. On gelatin stab, there is no deep growth. After a while, cerebriform whitish masses appear just below surface growth. In peptone water, growth is mainly surface with some ''puffy balls.'' Glucose peptone water is acidified but not fermented. Litmus milk turns acid and clots. Surface growth is yellowish. Coagulated blood serum shows a very slow white growth with rare conidiophores. It is eventually liquefied. Gelatin is not liquefied.

Aspergillus Mencieri Sartory & Flamant Apud Sartory, Champ. Paras. Homme Anim. 578, 1922.

Aspergillus sp. Sartory & Flamant, C. R. Soc. Biol. **93**: 1114, 1115, 1920.

Isolated from sputum of one suspected of having tuberculosis. Found three times. Not pathogenic to laboratory animals.

Mycelium branched. Conidiophores erect, 220-740μ high, 14-16μ in diameter. Vesicle 30-50μ in diameter, green at first, becoming brown. Phialides on upper half of head only, irregular but usually twice as long as wide. Conidia irregular, 9-12μ in diameter. Disjunctors present. Perithecia canary yellow on carrot or potato, 200-220μ in diameter, with a bright yellow membrane. Asci spherical, 15-20μ in diameter, 8-spored. Spores lenticular with groove and crest along greatest diameter, 10 × 4.7μ.

Mycelium sprouts on carrot, potato, and liquid media. Growth good on the usual media. Glucose only fermented. No action on starch, cooked rice, egg albumen, coagulated serum. Milk coagulated and curd dissolved. Gelatin liquefied.

Aspergillus Amstelodami (Mangin) Thom & Church, Aspergilli 113, 1926.

Eurotium Amstelodami Mangin, Ann. Sci. Nat. Bot. IX, **10**: 360, 361, 1909.

This species is a common saprophyte that from time to time has been reported pathogenic. Weil, Gregoire, Chevallier & Flandrin (1928) claim to have isolated this species from splenomegaly [probably as a contaminant]. Duché describes a var. *alophote* similar to the species, but lacking the crest on the ascospore. Fonseca (1930) reports this species from a case of mycetoma of the foot with yellowish grains, his organism being determined by Mangin.

Conidia green, spherical, finely echinulate, 2.8-4.7μ or somewhat ellipsoid (Fig. 100, *A*), larger at lower temperatures (5.6 × 7.5μ at 10° C.). Perithecia numerous, yellow, deeply surrounded by floccose mycelium; ascospores with furrow only, hyaline, smooth, 4.7 × 3.7μ (Fig. 100, *B, C*).

Colony floccose, tardily green, glaucous or olive green.

Aspergillus ruber (Spieckermann & Bremen) Thom & Church, Aspergilli 112, 1926.

Eurotium rubrum Spieckermann & Bremer, Landw. Jahrb. **31**: 81-128, 1902. Case by Agostini, Atti Ist. Bot. R. Univ. Pavia IV, **2**: 65-77, 1930 [1931].

Isolated from small subepidermal abscesses in the hairy areas of head which open to the surface by small yellow orifices, covered by a purulent crust. Pathogenic for white rats, producing ulcers.

Conidiophores arise either from submerged or aerial hyphae, 120μ long and more, when forking from the latter, up to 300-500μ or even 800μ in length and 8-16μ in diameter. Vesicle clavate to subspheric, 24-30μ in diameter, phialides radiating, 4-12μ, mostly 6-10μ by 2-4μ. Conidia ovoid to spherical, 5-8μ in long axis, rough, pale green (blue green in mass). Perithecia globose, yellow then rusty brown, 80-120μ in diameter; asci 10-12μ in diameter; ascospores 6 × 4-5μ with shallow, smooth furrow, no frill or ridges.

Colonies more or less floccose, at first white, then bluish green with developing conidia, then through yellow to rusty red throughout and intense red in the substratum.

Aspergillus montevidensis Talice & Mackinnon, Soc. Biol. Montevido 61 Sesión. 4 pp. 1931; Reunión Soc. Argent. Patol. Reg. del Norte, Tucumán **7**: 278-284, 1932.

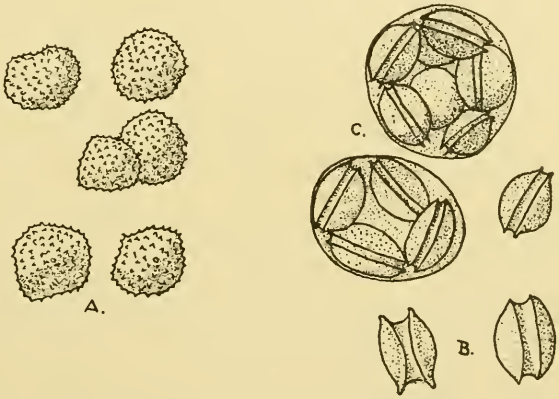

Fig. 100.—*Aspergillus Amstelodami.* *A*, conidia; *B*, ascospores; *C*, asci containing ascospores. (After Fonseca 1930.)

Isolated from a case of otomycosis in Montevideo.

Tympanic membrane was covered with dark, slightly adherent spots in which the *Aspergillus* was demonstrated.

Fertile mycelium at first glaucous (glaucus 38 Saccardo, *Chromotaxia*), then yellowish (flavo-virens 33 Saccardo), and finally yellowish green (olivaceus 39 Saccardo). Sterile mycelium white or grayish (cremeus 27 Saccardo). Conidiophores, 55-234μ long (mean 170μ) by 5.1-8.5μ in diameter (mean 23μ), not visible on casual inspection, smooth, terminating in a spherical vesicle, 13.5-25.5μ in diameter (mean 18.7μ), of greenish or yellowish green color. Phialides elongate, inserted over almost the entire surface of the vesicle, not crowded, 6.8-13.6 × 2.5-3.4μ (mean 10.8 × 3μ). No secondary phialides. Conidia usually ovoid, sometimes ellipsoid or spherical, 3.4-5.6μ in diameter (mean 4.9μ), generally smooth and forming short chains which are easily broken up in the making of preparations. Fertile perithecia abundant, greenish yellow, each having a variable number of asci with 8 ascospores per ascus. Spores grooved and crested, the latter visible but not very distinct. Perithecia 34-102μ in diameter (mean 68μ); asci 7.6-11.4μ in maximum diameter (mean 10.6μ); ascospores 5.45 × 3.75μ. Optimum temperature for growth 25°-30° C.

On glucose peptone agar a diffusible yellow pigment is formed. Gelatin is not liquefied within 10 days.

Aspergillus Fontoynonti Guéguen, C. R. Soc. Biol. **66**: 1052, 1053, 1909; **67**: 10-12, 1909; Arch. de Parasitol. **14**: 177-192, 1911.

Isolated from secondary abscesses in the cervical region of a European resident in Madagascar, not from "*nodosités juxta-articulaires*" as first reported by an epistolary error. Abscess was on indurated base in the hypoderma, nearly painless, about the size of a large nut. Full case history given. Medication with 2 gm. KI per diem for several months successful. Intravenous or intraperitoneal injection into rabbits, guinea pigs, or pigeons gave negative results.

Conidiophores about 150-200μ high, excipuliform, subcontinuous, 14-18μ in diameter. Phialides of flask shape, 8-12 × 2μ, giving rise to chains of 10 to 30 glaucous conidia which are spherical to ovoid, 4-6 × 3-5μ, more or less covered with extremely fine warts. Conidia in short flammiform plumes, rarely cylindric. Early subcultures with heads proliferating and very irregular. Later subcultures more regular, optimum temperature 22°-25° C., no growth at 37° C.

On gelatin, there is visible growth by the fourth day with variable glaucescence. On agar, growth with less glaucescence, culture becoming greenish gray. On potato, punctiform colonies appear on the fifth day and become confluent on the ninth, show few conidiophores and remain dirty white. On glycerol potato, growth less abundant and white. On carrot, growth visible the fourth day, pale glaucescence the eighth, with finally a large elevated cushion. On Jerusalem artichoke, culture turns green on the eighth day and color is somewhat deeper in 3 weeks. No growth on Raulin's normal medium. On Raulin's neutral medium, punctiform colonies appear on fourteenth day with grayish, circular covering the third week. On Raulin's normal gelatin, very small star-shaped colonies appear on the tenth to twelfth days, fruiting in 3 weeks, greenish white. On Raulin's neutral gelatin, growth better, no liquefaction after 40 days. In peptone broth, fructifications in 12 days, glaucous color third week. Coagulated albumen shows white punctiform colonies on the eighteenth day and thereafter is stationary for one month. Organism grows on a variety of sugars but best on maltose. It hydrates urea with feeble formation of NH_3. Milk is coagulated in 12 days, with curd subsequently digested into a citron yellow liquid with light chalky sediment. Plain gelatin liquefied after a month.

Aspergillus malignus (Lindt) Thom & Church, Aspergilli 132, 1926.

Eurotium malignum Lindt, Arch. Exp. Path. Pharm. **25**: 256-271, *Figs. 1-11,* 1889.

Obtained from human ear. Pathogenic to puppies, with production of extensive lesions.

Conidiophores up to 1,000μ long; vesicles 22-24μ in diameter, approximately spherical instead of cylindric, phialides hyaline, 10 × 4-4.5μ, more or less divergent, covering upper two-thirds of the vesicle [while in *A. fumigatus* the upper half only is covered, and the phialides measure 8 × 3-4μ]. Conidia 3-4μ in diameter. Perithecia are common, being particularly abundant on bread. They are white, of woven hyphae, 40-60μ in diameter, surrounded by a pseudoparenchyma. Asci 8-spored, 14-18μ in diameter, spherical, scattered throughout the sclerotioid perithecium. Ascospores produced on bread in 7 days. Spores lenticular or biconvex, 6-8μ in long axis, colorless, having a thick exospore with two ridges and a furrow and some markings on surface of the valves.

Colonies on agar gray blue.

Judging from the figure, the antheridial hypha degenerates, unless Fig. 6 shows a much younger stage than interpreted by the author.

Aspergillus fumigatoides Bainier & Sartory, C. R. Soc. Biol. **66**: 22, 23, 1909; Bull. Soc. Myc. France **25**: 111-118, *Pl. 5,* 1909.

A saprophyte found to be pathogenic to rabbits on inoculation.

Foot tortuous, without partition, lightly and progressively curved from bottom upward. Conidiophore short, 50-310μ high, 5-6μ in diameter at the base. Vesicle 30-35μ broad, phialides 8-14μ long, wholly covering the vesicle, colorless. Conidia dark olive, ovoid, small, 2-3μ in diameter. Perithecia appear on solid media, 65-92μ in diameter, collected in masses. Asci spherical to ovoid, 20-26 × 12-18μ with usually 8 ascospores per ascus, rarely 4, spherical, 3-3.5μ in diameter, rough. Organism not very heat resistant, dying at 48°-49° C.

Color of cultures on carrot slightly green, not ashy gray fuliginous and blackish as in *A. fumigatus.*

Aspergillus bronchialis Blumentritt, Ber. Deutsch. Bot. Ges. **19**: 442-446, *Pl. 22, Figs. 1-6,* 1901; **23**: 419-427, *Pl. 19, Figs. 1-3, 6-8, 19, 23,* 1905.

Found by Chiari in the bronchial tubes of a diabetic patient. Studied by Blumentritt. Not pathogenic to dogs and guinea pigs, pathogenic to hens and pigeons (Luksch 1902).

Aerial hyphae 5-8μ, submerged hyphae 2-4.2μ, conidiophores erect, simple, seldom septate, hyaline, 280-300μ tall; vesicle 12-19μ, conidia gray, greenish gray, and brownish, depending on medium, mostly gray green.

On agar colony, at first white, then greenish, becoming dark green or brown. On broth, white pellicle becomes green, tube finally filled with mycelium; obligate aerobe. On gelatin, colonies as on agar, gelatin liquefied after a few weeks.

Colony floccose in contrast to velvety in *A. fumigatus.*

Aspergillus virido-griseus Costantin & Lucet, Ann. Sci. Nat. Bot. IX, **2**: 119-171, 1905.

Pathogenic to rabbits, not to fowls. Mori (1916) isolated it from the pleuropulmonary exudate of goat.

Colonies very floccose, areas partly white, partly gray, cream gray to dark gray green or green; conidiophores thin-walled, septate, undulate, slightly colored or tardily colored near the vesicle, 400-620μ long, vesicle 25-36μ in diameter, phialides 5μ in length; conidia 2.8μ in diameter.

Doubtfully distinct from *A. fumigatus.*

Aspergillus fumigatus Fresenius, Beitr. z. Myk. 81, *Pl. 10, Figs. 1-11,* 1850.

Aspergillus glaucoides Spring, Bull. Acad. Sci. Belg. **19**: 560-572, 1852.

Aspergillus nigrescens Robin, Hist. Nat. Veg. Paras. 518, *Pl. 5, Fig. 2,* 1853.

Aspergillus pulmonum-hominis Welcker in Küchenmeister, Die in und auf des lebenden Menschen vorkommenden Parasiten. II. Pflanzliche Parasiten 144, 1855: Dusch, Arch. Path. Anat. Phys. [Virchow] **11**: 561-566, 1857.

Aspergillus ramosus Hallier, Zeitschr. Parasitenk. **2**: 266-269, *Pl. 6, Figs. 1-6,* 1870.

Aspergillus aviarius Peck, N. Y. State Museum Rept. **44**: 120, *Pl. 4, Figs. 9-12,* 1890 [1892].

Aspergillus fumigatus var. *alpha* Sion & Alexandrescu, C. R. Soc. Biol. **64**: 288, 289, 1908.

This is the commonest species isolated from cases clinically resembling tuberculosis of the lungs in which *Mycobacterium tuberculosis* has not been found. Apparently causing severe epizoötics in birds, less fatal in man, and not reaching epidemic proportions. Pathogenic for laboratory animals.

Conidiophores short, usually densely crowded, as long as 300μ (rarely 500μ) by 2-8μ in diameter, more or less green in color, especially above, arising either from submerged or aerial hyphae, septate or unseptate, enlarging toward the top with flask-shaped vesicles, 20-30μ in diameter, usually fertile only on the upper half. Primary phialides only, 5-10 (mostly 6-8) × 2-3μ, crowded, with axis approximately parallel to axis of the conidiophore. Together with the chains of conidia, the growth is occasionally about 400μ high, though usually shorter, and measures 50μ across at the top. Conidia appear dark green, spherical, 2-3.5 (mostly 2.5-3)μ in diameter. Growth good at 37° C.

Colonies on Czapek's solution agar velvety to felted floccose, green to dark green to almost black in age, spreading. Reverse and medium colorless to yellow, occasionally reddish in age.

On the basis of ascospores reported by Sartory, C. R. Acad. Sci. **183**: 1360-1362, 1926, Vuillemin erected *Sartorya fumigata* (Fresenius) Vuillemin. C. R. Acad. Sci. **184**: 136, 137, 1927.

Perithecia in sclerotia, walls of several cell layers, spherical; asci ovoid or spherical, thin-walled, disappearing at maturity. Ascospores 8, ellipsoid, thick-walled, black at tips, lighter in center; perithecia 70-110μ in diameter; asci 15-22.5μ; ascospores 4-6.25μ long, perithecial filaments 3-5.5μ in diameter, walls 0.8-1.2μ thick.

The perithecia were reported following treatment with x-rays. This work has not been confirmed. Previous reports of perithecia in this species have all been shown later to be erroneous.

Var. **minimus** Sartory, Bull. Acad. Méd. Paris, III, **82**: 304, 305, 1919.

Isolated from the sputum of a tuberculous suspect. Pathogenic to rabbit and guinea pig.

Mycelial hyphae 2-3μ in diameter, forming a close felt. Conidiophores erect, slightly tortuous, 100-150μ long by 4-5μ in diameter, near base (gradually enlarging upward), fuliginous gray at the base, deepening in color toward the head, vesicle spherical, 20-25μ in diameter, covered in upper half or two-thirds by phialides 5-8μ long. Conidia spherical, rarely ellipsoid, 2-3μ in diameter, bronzed. No perithecia found on any media tried. Growth good at 37° and ceases at 42° C.

Organism has been grown on starch paste agar, Raulin's agar, gelatin, Raulin's sucrose, glucose, maltose, and lactose media. Sucrose is inverted. Neither glucose, maltose, nor lactose is fermented. Starch liquefied with reducing sugars present by the fifth day. Egg albumen unchanged. Milk coagulated on tenth day, transformed to an opalescent liquid. Gelatin liquefied in 8 days (color 373, Code des Couleurs).

Aspergillus tunetaneus (Langeron) Dodge, n. comb.

Sterigmatocystis tunetana Langeron, Bull. Soc. Path. Exot. **17**: 345-347, *1 fig.*, 1924; Blanc & Caillou [case history only], Bull. Soc. Path. Exot. **17**: 343-345, 1924.

Isolated from tumors between the third and fourth metacarpals on the left hand of a native of Tunis. Tumors removed surgically. Animal inoculations negative.

Conidiophores simple, 200μ high by 2.5-4μ in diameter, not septate except in old cultures. Vesicle hemispheric above, obconic tapering below, varying with age from 5-10μ in diameter, the average being 7-8μ. Primary phialides short, oblong to inverted conical, 6-8 × 2.5-3.5μ. Secondary phialides ampulliform with more or less elongated beak, in groups of two to three, measuring 7-8.5 × 3-3.5μ. Conidia spherical, minutely verrucose, 3-3.5μ in diameter, in long chains, greenish under the lens, deep blue green in mass (390-395, *Code des Couleurs*) and remaining so even after the mycelium is red. Optimum temperature 25°-30°, growth weak at 37° C.

Colonies white, then green blue (368, *Code,* later 390-395), later orange (121, *Code,* ochraceus 29 of *Chromotaxia*) finally becoming orange (113, *Code,* fulvus 32 of *Chromotaxia*).

Aspergillus Brodeni (Mattlet) Dodge, n. comb.

Sterigmatocystis Brodeni Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 31, 1926.

Sterigmatocystis cas I, II, IV Mattlet, Ann. Soc. Belge Méd. Trop. **4**: 3: 167-176, *3 figs.*, 1924.

Isolated from bronchomycoses with abundant sputum containing spores and later some filaments of *Aspergillus,* no trace of *Mycobacterium tuberculosis* either in smears or guinea pig inoculation. First case fatal (refused medication), the second, a prisoner, partially recovered and disappeared, the third case apparently cured by KI.

Colonies greenish from conidia, sterile mycelium white. Mycelium variable, 1-3μ in diameter, cylindric, ovoid, or spherical chlamydospores, 6-7μ in diameter. Conidiophores 100-350μ high, vesicle ovoid, 16 × 20μ, whole surface covered with phialides, 18-22 per great circle, 4μ long. Three to four secondary phialides per primary phialide, 1-2 × 5-6μ. Conidia in chains, 3μ in diameter, finely echinulate and bright green.

Var. **Vancampenhouti** (Mattlet) Dodge, n. comb.

Sterigmatocystis Vancampenhouti Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 31, 1926.

Sterigmatocystis cas III, Mattlet, Ann. Soc. Belge Méd. Trop. **4**: 167-176, *3 figs.,* 1924.

Isolated from bronchomycosis, cases similar to those reported in *A. Brodeni.* Recovery followed KI-emetine treatment.

Close to *A. Brodeni* but less velvety, deeper green, with radial furrows in the colonies. Conidiophores very similar as to shape and size. Conidia bottle green, spherical, 3-4μ in diameter, or ovoid, 3 × 5μ.

Aspergillus cyaneus (Mattlet) Dodge, n. comb.

Sterigmatocystis cyaneus Mattlet, Ann. Soc. Belge Méd. Trop. **6**: 32, 1926.

Isolated from a case of chronic bronchitis with a little emphysema. Author unable to follow up case (Tamahunga).

Mycelium white, hyphae variable, 1-5μ in diameter. Conidiophores 3-4μ in diameter by 150-300μ high. Primary phialides 3 × 8-10μ, secondary phialides about 1.5-2 × 4-6μ; conidia blue gray, smooth or echinulate, 3μ in diameter. Colony appears grayish blue, interrupted by straw yellow areas formed of many cespitose sclerotia (suggesting raspberry). Sclerotia [perithecia?] vary from 120-350μ in diameter and are composed of polyhedral cells, 5-18μ in diameter with very thick walls, 4-6μ in larger cells. Sclerotia hollow and allow a large volume of fatty droplets [ascospores?] to escape. Optimum tempcrture 30°-37° C.

Aspergillus nidulans (Eidam) Lindt, Arch. Exp. Path. Pharm. **21**: 284, 1886.

?Otomyces purpureus Wreden, Arch. Augen-Ohr-Heilk. **3**: 56-90, *Pl. C,* 1874.

Sterigmatocystis nidulans Eidam, Beitr. Biol. Pflanzen [Cohn] **3**: 392-411, 1883.

Diplostephanus nidulans Neveu-Lemaire, Précis Parasitol. 101, 1921.

Emericella nidulans Vuillemin, Champ. Parasit. 58, 1931. Examination of the Berkeley type in the Curtis herbarium shows that *Emericella* is unrelated to *A. nidulans.*

Found by Siebenmann in 2 cases of otomycosis.

Conidiophores cinnamon brown in color, more or less sinuous, septate or not, 50-100μ, rarely 200 μ long by 3-5μ in diameter at base, increasing gradually to obconic vesicle, glaucescent, becoming brown, 12 × 10μ. Primary phialides approximately 5-8 × 2-3μ, secondary usually also present, 7-10 × 2-2.5μ. Conidia spherical, 3μ in diameter, in chains. Perithecia in a nest of hyphae, spherical, 200-300μ in diameter. Asci 10.5-11μ in longest axis, 8-spored, filling the perithecia. Ascospores purple brown, slightly ovoid, 4 × 5μ, with a frill, giving the appearance of a biconvex lens, separating into two valves on germination.

Colonies on Czapek's solution agar, white to yellowish green or fairly deep green, velvety to more or less floccose in purely conidial areas, becoming definitely floccose when perithecia are forming. In ascosporic strains, colonies floccose with conidium production much reduced and green color absent or nearly so. Reverse and medium usually reddish to dark red or red brown.

Perfect stage of *A. fumigatus* described by Grijns, 1903, belongs here (see Pinoy & Masson, 1915).

Var. **Nicollei** Pinoy, apud Nicolle & Pinoy, C. R. Acad. Sci. **144**: 396, 397, 1907.

Sterigmatocystis nidulans var. *Nicollei* Pinoy apud Nicolle & Pinoy, Arch. de Parasitol. **10**: 457, 458, *1 pl.*, 1906.

Diplostephanus nidulans Neveu-Lemaire var. *Nicollei* Neveu-Lemaire, Précis Parasitol. Hum. 101, 1921.

Isolated from a case of Madura foot in Tunis. Tissues of the foot extensively invaded by the parasite. Puestow (1929) reports this organism from a case of maduromycosis of the forearm and mycetoma back of the right ear. (Organism determined by Thom as *A. nidulans.*) Not pathogenic to guinea pigs or rabbits.

Young mycelium colorless. Conidiophores erect, simple, continuous or rarely septate, glaucescent or sometimes brownish, 800μ long by 4μ in diameter, head obconic, 12 × 10μ. Primary phialides 8 × 3μ with two, rarely four, secondary phialides to each. These are 4 × 2.5μ, each giving rise to a chain of conidia, spherical, 2-3μ in diameter, smooth or slightly roughened, somewhat green. Chlamydospores terminal, spherical, 8-16μ in diameter, brownish. Sclerotia black brown, 50-300μ in diameter, embedded in nests of hyphae. Optimum temperature 36°-38° C.

Var. **Cesarii** Pinoy & Masson, Bull. Soc. Path. Exot. **8**: 11, 12, 1915.

Caused mycetoma in the lung of an ass.

Phialides often simple and inserted near the base of the vesicle. Conidia 3μ in diameter. Perithecia fertile, ascospores 4.1 × 4μ. Membrane turns brown rapidly.

Aspergillus unguis (Weill & Gaudin) Dodge, n. comb.

Sterigmatocystis unguis Weill & Gaudin, Arch. Méd. Exp. Anat. Path. **28**: 463-465, *Pl. 12*, 1919.

Found on rather superficial lesions of nail of great toe in deeply penetrating brownish crevices of the nail, the remainder of which is deep yellow with a marbled appearance resulting.

Mycelium 2-5μ in diameter (mean 3μ). Conidiophores simple, nonseptate, of uniform width, 250-300 × 5μ. Vesicle spherical, 12μ in diameter, or pyriform, 14-16 × 8μ. Primary phialides cylindric, 5 × 3μ. Secondary phialides flask-shaped, 6μ long to the base of the neck and 3μ in diameter, four per primary phialide. Conidia spherical, 3μ in diameter, becoming slightly verrucose in age, brownish in original lesions. Optimum temperature 30° C.

Colonies at first white, then greenish or chrome green in center, then dirty, finally becoming chocolate brown. Almost always brown at 37°C. Giant colony after 10 days is 2 cm. in diameter, white, velvety, with center slightly depressed. Growth good on the usual laboratory media; e.g., Sabouraud maltose, carrot, Raulin's medium.

Aspergillus Jeanselmei Ota, Ann. Parasitol. Hum. Comp. **1**: 137-146, 1923.

Found on the nails of an old man in Paris. Nails had disappeared from all but four fingers, where they were deformed, thickened, grayish yellow. On other fingers there were thick crusts in place of the nails. Epidermis not affected.

Mycelium branched, sparingly septate, $2\text{-}5\mu$ in diameter, sometimes 7μ in young cultures. Conidiophores $100\text{-}400\mu$ long, rarely 80μ, expanding gradually from $4\text{-}5\mu$ at the base to nearly 8μ in diameter at the top. Heads including phialides and conidia measure $16\text{-}29\mu$ across, occasionally up to 50μ when both primary and secondary phialides are present. Phialides mostly simple, cylindric or flask-shaped, $4\text{-}10 \times 3\text{-}5\mu$, or when in two rows, the primary cylindric or slightly clavate, bearing two secondary flask-shaped phialides, $10\text{-}15 \times 5\mu$, to each (Fig. 101). Conidia spherical, sometimes ovoid, $3.5\text{-}6.5\mu$ in diameter (mean 5μ), slightly green, becoming reddish brown in 7-month-old cultures, sometimes slightly verrucose, in long chains.

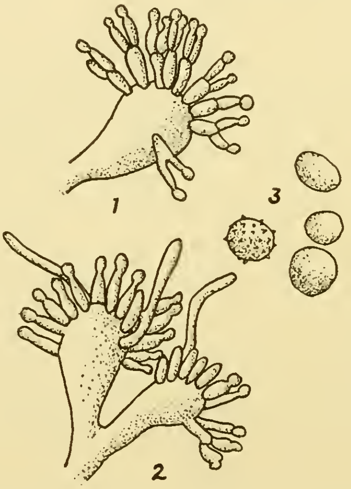

Fig. 101.—*Aspergillus Jeanselmei.* *1,* normal conidiophore; *2,* branched conidiophore, showing abnormal phialides; *3,* conidia (*1* and *2* ×300; *3* ×400). (After Ota 1923.)

On malt agar, glucose agar, carrot, or potato at 25°, mycelium white, greening on the third day, remaining yellowish green for months. On malt agar at 35°, growth is more rapid with colony turning green the second day. Colony on glucose agar becomes chocolate brown, with a greenish lustre in

7 months. On egg albumen, growth is feeble, granular, greenish brown. Conidia not produced on peptone agar without sugar.

Mackinnon (1932) refers this species to *A. flavus* Link.

Doubtful Species

There is little to distinguish *Sterigmatocystis tropicalis* Matta, Bol. Inst. Brasil. Sci. **3**: 51-54, *2 figs.*, 1927, from *Aspergillus tunetanus*, except its vermilion color. It was isolated from ulcerous lesions on the back of the foot, removed surgically.

PENICILLIUM

Penicillium Link, Mag. Ges. Naturf. Freunde Berlin **3**: 17, 1809.

The type species is *Penicillium expansum* Link.

Vegetative mycelium abundant, entirely submerged or more or less effused, monopodially branching, septate, commonly showing vegetative anastomoses, colorless or secondarily colored by products of metabolism which frequently also discolor the substratum, never with hyphal walls brown or black; colonies greenish or less commonly colorless, hazel, yellow, reddish, purplish or other shades; conidiophores arising as branches from the vegetative mycelium, frequently perpendicular to the vegetative hyphae, but not showing differentiated foot cells as in *Aspergillus*, with walls in some species smooth, in others more or less conspicuously pitted or roughened from secondary thickening; conidial apparatus forming a brush or broom, the penicillus, ranging from a single terminal verticil of conidiiferous cells or phialides or a terminal verticil of equal branches or metulae, bearing phialides in verticils; phialides bearing single unbranched chains of conidia, each cut off as a cylindric segment from an apical tube; conidia cylindric to ovoid, ellipsoid or commonly finally spherical, smooth or roughened, hyaline or variously colored, especially in mass; sclerotium or perithecium formation known only in a few species.

While *Penicillium* is frequently mentioned in medical literature, there are only two references where the organism has been sufficiently described to be sure that it belongs in this genus. With the exception of *P. mycetomatogenum* and *P. Bertai*, none of the descriptions are adequate to permit identification of a modern culture as probably belonging to them. In general, it seems that the imperfectly described organism was picked up as a contaminant, and there is a probability of pathogenicity in only one of the cases cited.

Penicillium Bertai Talice & Mackinnon, Ann. Parasitol. Hum. Comp. **7**: 97-106, 1929.

Isolated from case of chronic pseudotuberculosis on three successive occasions. Not pathogenic for rabbit and guinea pig.

Mycelium rampant, hyaline at first becoming yellow, about 2.5μ in diameter (2-4), with a tendency to become funiculose. Conidiophore erect, 20-90μ × 2μ, tip enlarged to 3.2 (2-4.5)μ terminated by up to 5 phialides, about 9 × 2.2μ (6-16 × 1.5-3.5), which produce chains of conidia up to 20μ. Conidia smooth, spherical, 1.7-3.5μ in diameter (Fig. 102).

Grown on neutral Raulin's (Diercks) medium, beef broth gelatin, malt, agar, bread, potato, and Sabouraud agar (prepared according to the directions of Biourge). Stab colony white with sulphur colored center, then green (glaucus of Saccardo *Chromotaxia*) finally dark green (atrovirens), reverse sulphur. Streak practically same color, changes finally, folded and fuliginous (11 Saccardo *Chromotaxia*), reverse luteous, the orange finally badious in the central zone with clear orange (137, *Code des Couleurs*). In beef gelatin, the reverse finally becomes ferruginous. In Sabouraud's conservation agar, colonies remain pinkish white (53a, *Code des Couleurs*).

This organism belongs in the Aspergilloid section, close to *P. platense* Spegazzini.

Penicillium mycetomagenum Mantelli & Negri, Giorn. R. Accad. Med. Torino **78**: 165, 166, 1915 [as *P. mycetogenum*]; Negri Atti R. Accad. Sci. Torino **66**: 67-78, 1921.

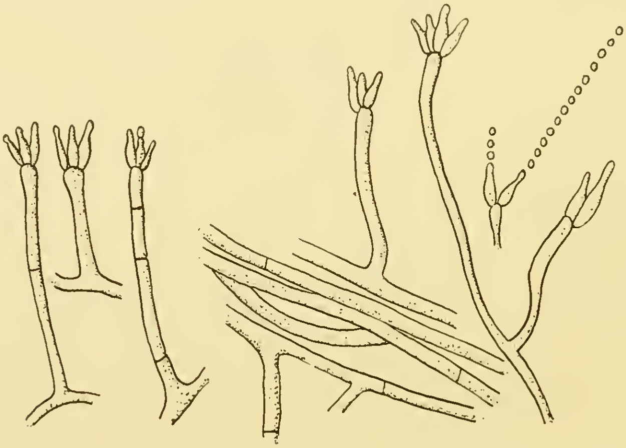

Fig. 102.—*Penicillium Bertai.* (After Talice & Mackinnon 1929.)

Isolated from the foot of a man of thirty in Turin, Italy. The foot had been stepped on by an ox and gradually developed lesions which did not respond to iodine or KI treatment and finally, after 3 years, had to be amputated. In section, the foot showed a fibrous periphery and a soft interior filled with black grains. Organism pathogenic to pigeon but not to guinea pig.

In grains, hyphae septate, crowded into pseudosclerotia, subspheric or lobate, carbonaceous, 200-500μ in diameter, solitary or in groups of two or three. Outer hyphae of the granules larger, 2.2μ in diameter, shorter, twisted and with a clavate apex, bound together into a crust by a black cement. Central hyphae are hyaline, 1.5μ in diameter, with conidial cells larger, some terminal, ovoid or pyriform, 3-4μ in diameter, with some larger intercalary ones 6-10.5μ (Carter's capsules). In cultures chlamydospores 4-5μ in diameter, yellowish gray, blackening the substrate, reproducing abundantly at 20°-25° C., but growing slowly and normally between 3° and 37° C., hyaline, septate. Conidiophores not in coremium, septate, 2-3 furcate with the next rank verticillate, umbellate, 50-60μ beyond bifurcation. Primary phialides 7.5-1.2μ long, secondary phialides spherico-depressed, 3.7μ in diameter. Conidia spherical, 2.2-3.7μ, smooth, hyaline, acruginous greenish, never long catenulate.

Growth on glycerol or Sabouraud agar from isolation, colonies round, slightly umbilicate, grayish white or gray, velvety, hyphae radiating from the middle, finally giving a hemispheric effect. On potato, bread, sugar carrot, glycerol carrot, or orange, colonies ragged, floccose, moderately rugose or undulate, completely covering the substrate, at first white then, on appearance of fructifications, aeruginous green and mouse color. Reverse cream colored, with edge blackening in age. No odor. On pear and apple, an arachnoid colony is formed. Colony on gelatin is round, plane, slightly ochraceous. In bean decoction, with or without sugar or glycerol, growth is at first immersed, with the formation of a basal veil of hyphae, which are hyaline, septate, 1.5-2μ in diameter, with intercalary chlamydospores, the latter ovoid, 8-12μ in diameter. Later there appears a supernatant pellicle with normal conidiophores and hyphae. Litmus agar is turned slightly alkaline. Gelatin not liquefied.

Penicillium Giordanoi Vuillemin, Champ. Parasit. 62, 1931.

P. glaucum Giordano, Annali. Med. Nav. Colon. **24**: 567, 1918, non aliorum.

Producing fatal pseudotuberculosis.

I have been unable to see a copy of this work.

Penicillium minimum Siebenmann, Die Schimmelmykosen der menschlichen Ohres. 82, 83, 1889.

Penicilliumähnlich Bezold, Arch. Ohrheilk. **25**: 1885.

Isolated from a case of catarrh of the middle ear following scarlet fever. Three years later the organism was found abundantly fruiting in epidermis and a large, crouplike membrane.

Mycelium 2μ in diameter. Conidiophores up to 20μ long, septa 6μ apart. Conidia 2.5-3μ in diameter and about the color of those in *Aspergillus niger.*

The case cited by Buscino & Cardia appears somewhat doubtful. The figures suggest an *Aspergillus,* although the organism was determined by Pollacci as *P. minimum.*

Penicillium crustaceum [Linné] Fries, Syst. Myc. **3**: 407, 1832.

Mucor crustaceus Linné, Species Plantarum, 1186, 1753.

Monilia digitata Persoon, Syn. Fung. 693, 1801.

Penicillium glaucum Link, Mag. Ges. Naturf. Freunde Berlin **3**: 17, 1809.

Greco, Origine des Tumeurs . . . 67-122, 1916, reports this species as the etiologic agent in 3 cases. He gives much detail, but absolutely no evidence that the organism cultivated was the etiologic agent or that the *Penicillium* isolated was this species. The cases were undoubted mycoses and showed septate, occasionally binucleate mycelium but he was consistently unable to reproduce in animals with his cultivated organism either the lesions produced by inoculations with uncontaminated pus from the human lesions or the lesions as they appear in human subjects.

Penicillium Montoyai Castellani & Chalmers, Man. Trop. Med. ed. 1, 614, 1910.

Penicillium pictor Neveu-Lemaire, Précis Parasitol. 1908.

Isolated by Montoya y Flores (1898) from a grayish violet pinta.

Hyphae branch dichotomously. Spore chains with more or less cylindric sporophore. Penicillus short and has only a few branches. Conidia spherical or ovoid, smooth, 3-4.5μ in diameter.

Organism grows well on ordinary agar and maltose agar. On glycerol agar, colony is woolly, short, kinky, white at first, becoming glaucous and finally violaceous, old cultures presenting rose-colored mammillae, with reverse rose. Glycerol broth shows a pellicle with smooth white tubercles, broth becoming yellow as picric acid.

Penicillium pruriosum Salisbury, 1873, Marchand, Bot. Crypt, lec. 1880.

Isolated from mucous membrane of vulva and vesica urinaria.

Penicillium quadrifidum Salisbury Zeitschr. Parasitenk. [Hallier] **4**: 3, *Pl. 6*, *Fig. 11,* 1875.

Isolated from the blood under fairly sterile conditions; this organism was seen in abundance in the freshly removed blood. The patient recovered after medication with 2 gm. of quinine and 20 drops of tincture Feni-chloride in a glass of water every four hours. In addition, the swollen surfaces were painted with tincture of iron every 3-4 hours.

Kesten et al. (1932) report *Penicillium spiculisporum* Lehman from open ulcers on the toes, but were unable to reproduce the lesions on experimental animals.

PAECILOMYCES

Paecilomyces Bainier, Mycothèque de l'Éscole de Pharmacie **11**: Bull. Soc. Myc. France **23**: 26, *Pl. 7,* 1907.

Type species is *P. varioti* Bainier.

Phialides short, tubular, or more or less enlarged, tapering into long conidiiferous tubes, curved or bent slightly away from the long axes of the phialides; variously arranged, partly in verticils and branching systems suggesting *Penicillium*, partly irregularly arranged upon short branchlets, partly arising singly along the fertile hyphae; conidia in chains, never green; macrospores variously borne, usually solitary and terminal on branchlets either submerged or close to the substratum (Fig. 103).

It is possible that some species described as *Spicaria* should be placed here. The nomenclature of *Spicaria* is involved, having been used in various senses by various authors, so that it seems wiser to retain *Paecilomyces* than to treat it as a synonym as was done by Gilman & Abbott (1927).

Paecilomyces Burci (Pollacci) Thom, Penicillia 548, 1930.

Penicillium Burci Pollacci, Atti Ist. Bot. R. Univ. Pavia **18**: 128, 129, *Pl. 31,* 1921; Berti, Policlinico Sez. Chirurg. **29**: 484-486, *Figs. 1-5,* 1922; Campatelli, Pensiero Med. **12**: 217-219, 1923.

This organism was isolated by Berti from a small tumor along with *Acremoniella Berti* in Florence, and was also used by Campatelli to produce an experimental granuloma.

Specialized conidiophores scarcely found; penicilli consisting of single phialides or small, short-stalked clusters or verticils of phialides, each with its conidial chain, scattered along the separate hyphae or ropes of hyphae in large numbers; phialides 10-12μ with long tubes set at angles to their axes and divaricate when in verticils; conidia up to 6, 7 or even 8μ × 2.5-4μ, almost hyaline (Thom).

Colonies in Czapek's solution agar broadly spreading, forming a loose, bristly network of hyphae, making a funiculose felt 200-400μ deep, white with more or less yellow in areas, and with yellowish drops or their residue, reverse in yellow orange shades.

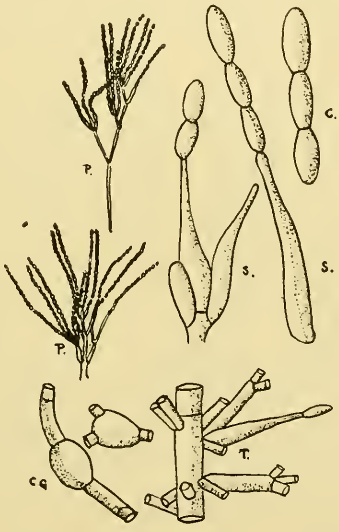

Fig. 103.—*Paecilomyces Varioti.* *C,* conidia; *CG,* germinating conidia; *P,* penicilli; *T,* section of a trailing hypha bearing phialides and various grades of penicilliferous branchlets. (After Thom 1910.)

Colonies on glucose agar, white floccose, then grayish chestnut. Sterile hyphae branched, hyaline, septate, creeping or ascending, 6-7μ in diameter. Conidiophores erect, simple, septate, hyaline, 50-110μ long, sparsely branched above, ending in chains of conidia. Conidia spherical, rarely ellipsoid, smooth, pale, fuliginous, 4-5μ in diameter. On broth, colonies floating, similar to those on agar.

SCOPULARIOPSIS

Scopulariopsis Bainier emend. Thom, Penicillia 511, 1930; Bainier, Bull. Soc. Myc. France **23**: 99-103, *Pl. 9, Figs. 1-6,* 1907.

Acaulium Sopp, Vidensk. Selsk. Skrift. I. Mat. Naturv. Kl. **1912**: 11:33, 42-46, 1912.

The type species is *Penicillium brevicaule* Saccardo.

Colonies never green, with aerial hyphae partly at least in trailing and anastomosing ropes or fascicles (funiculose); conidiophores very short or almost wanting, commonly borne along the funiculose hyphae; conidial apparatus as in *Penicillium,* consisting of varying aggregations of branches and phialides, at times reduced to single phialides scattered along aerial hyphae; phialides tapering gradually from a basal tubular section or even the base itself toward a conidiiferous apex, or narrowly tubular without tapering, abjointing conidia from the apex; conidia more or less pointed at the apex and truncate at the base with more or less thickened basal ring surrounding the basal germinal pore, with walls usually thickened and often variously marked or roughened (Fig. 104).

Sopp describes perithecia as showing small but definite ostioles. The species appear as agents of decomposition after the usual green *Penicillia* have ceased to be active; i.e., in the later stages of decay.

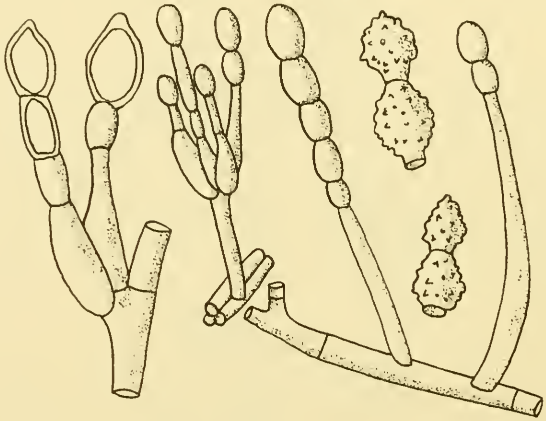

Fig. 104.—*Scopulariopsis brevicaulis* (Sacc.) Bainier. (After Thom 1910.)

While there is little real evidence that *Penicillium* is ever pathogenic, there is plenty of evidence for several species of *Scopulariopsis,* at least as invaders of the nails and secondary invaders, if not the primary cause of gummata and other lesions.

Key to Pathogenic Species

Perithecia present after 3 weeks, black, 250μ in diameter, asci evanescent, 8-spored, 10-12 × 8μ; ascospores brown planoconvex, 6-7 × 3-3.5μ.	*S. cinereus.*
Perithecia perhaps developing in time, but only rudiments observed, conidia smooth, colorless, 3-4 × 1.5-2μ.	*S. Blochi.*
Perithecia usually absent (not yet observed).	
Conidia smooth.	
Conidia yellow to tawny, 5-7μ.	*S. rufulus.*
Conidia hazel (avellaneous) 6-8μ.	*S. Koningi.*
Conidia brown (2-5μ).	
Phialides in groups.	*S. sehnsuchta.*
Phialides single.	*S. Bertacini.*

Conidia white.	
Conidia 3-4 × 1.5-2μ.	*S. Blochi.*
Conidia 1.25-1.5μ.	*S. minimus.*
Conidia rough.	
Conidia chestnut, 6μ.	*S. ivorensis.*
Conidia white.	
Conidia ellipsoid, 5.2 × 6.3μ, echinulate.	*S. sputicola.*
Conidia subcitriform, 7-9μ.	*S. Castellanii.*
Conidia some shade of yellow.	
Conidia canary yellow, 3-5μ.	*S. Mencieri.*
Conidia golden yellow, 3-4.5μ.	*S. aureus.*
Conidia pale yellow, 7 × 6μ.	*S. brevicaulis* var. *hominis.*
Conidia yellowish gray chestnut, 5-8 × 4μ.	*S. venerei.*

Scopulariopsis cinereus Weill & Gaudin, Arch. Méd. Exp. **28**: 458-460, 1919.

Found on infected toenails, which crumble into white layers with some yellower parts.

Mycelium and conidia brown in age. Conidia have a truncate base and pointed disjunctor, which is slightly longer than broad, 2.5-3 × 4-5μ. Coremia sometimes present. Chlamydospores up to 100μ, mostly terminal, sometimes intercalary. Perithecia develop in about 3 weeks at 25° C. They are spherical, surrounded by radiating mycelium, taking a full month longer to mature. Asci ovoid, 10-12 × 8μ, 8-spored, early diffluent. Ascogonium soon surrounded by other hyphae which make up the pseudoparenchymatous wall of the perithecium. Ascospores brown, planoconvex, 3-3.5 × 6-7μ. Optimum temperature 25° C.

Grows on usual *Penicillium* media and on sterilized toenails. Colonies at first white, then ashy, mouse-gray, becoming brown green in age. On Sabouraud maltose, in Erlenmeyer flask, after 16 days, colony attains 3 cm. in diameter, is white, radiating, granular with a large central prominence. Green circle near the periphery and outside it a white circle which remains white.

Scopulariopsis Koningi (Oudemans) Vuillemin, Bull. Soc. Myc. France **27**: 143, 1911.

Monilia Koningi Oudemans, Arch. Neerl. Sci. Exact. Nat. II, **7**: 287, *Pl. 21*, 1902.

Scopulariopsis rufulus Bainier, Bull. Soc. Myc. France **23**: 105, *Pl. 12*, 1907.

Vuillemin (1911) thinks this a synonym of *Penicillium brevicaule* Saccardo as does also Biourge (1923), excluding *Scopulariopsis rufulus* Bainier, also Weill & Gaudin, 1919.

Jannin (1912) isolated this from a gumma on the hand. Raymond & Parisot, 1916, isolated this organism from a number of cases of trench foot and gave a brief account of the lesions following experimental inoculations. Liégard, 1925, found it in ulcerated human eye. Originally obtained by Koning from humus or leaf mold in Holland.

Koning describes his organism as follows: Colonies on soil extract gelatin orbicular, subzonate, rosy avellaneous; hyphae all hyaline, 4-5μ in diameter, septate. Creeping hyphae dichotomously branched, ascending hyphae racemosely branched with phialides lageniform, 30-40μ long, bearing simple chains of conidia with as many as twenty in a chain. Conidia subspheric, apiculate at the apex, smooth, 6-8μ in diameter, delicately rosy avellaneous.

Scopulariopsis sehnsuchta Froilano de Mello, Bull. Soc. Path. Exot. **25**: 295, 296, 1932.

A saprophyte isolated from lesions produced by *Ectotrichophyton mentagrophytes (Trichophyton asteroides).*

Hyphae hyaline, branched; 2.5-3μ, conidiophores septate, bearing 2-8 phialides suggesting those of *Paecilomyces,* 20-150 × 2.15-3μ; metulae 5.5-7 × 1.5-2μ; phialides 3.5-11 × 1.5-3μ; conidia smooth, brownish, slightly ovoid in chains of 10-40 cells, 2-5μ in diameter or 4 × 2.5μ. Sclerotia 56-88 × 68-108μ; coremia also present.

On Czapek agar, colony velvety white, becoming chamois or golden yellow, more or less zonate, amber guttulate, reverse yellowish; later the colony becomes chestnut to clear chocolate; reverse almost black. On potato, bread, and liquid media, similar colors, sometimes with a slight heliotrope shade.

Scopulariopsis Bertacini Redaelli in Bertacini, Giorn. Ital. Derm. Sifilol. **75**: 783-828, *Pls. 1-9,* 1934.

Isolated from a fatal case of blastomycosis originating in Brazil, showing cutaneous ulcers mostly about mouth and neck with lesions in the lung, etc. Pathogenic for laboratory animals.

In tissues, cells 5-22μ mostly 10-12μ; primary mycelium 3.5-4μ; secondary mycelium 1.5-3μ; chlamydospores intercalary 20-25μ; phialides erect, short, clavate, tapering toward distal end, 4 × 6-10μ; conidia smooth spherical or slightly ovoid, slightly brownish, 3.5-4μ in diameter in chains of 5-6 spores, often only a single spore remaining attached. Some phialides are branched from the middle of the club.

On Sabouraud agar, colonies of compact yellowish white felt, glabrous, margin grayish white, in old cultures becoming mammillate, color varying from smoky gray to brownish, depending on substrate. On Pollacci agar, colony round, glabrous, moist, shining with small verrucose center which becomes cerebriform, margin white. On liquid media, colony forms dense yellow brown ring, grayish above, finally becoming a thick pellicle.

The relationship of this organism is not altogether clear. The colony on Pollacci agar suggests the imperfect Eremascaceae.

Scopulariopsis Blochi (Matruchot) Vuillemin, Bull. Soc. Myc. France **27**: 144-146, 1911.

Mastigocladium Blochi Matruchot, C. R. Acad. Sci. **152**: 325-327, 1911.

Named for Bruno Bloch, who first isolated it [Arch. Derm. Syphilis **108**: 477-512, *Pls. 19-21,* 1911].

Isolated from a case of gummatous lymphangitis, clinically resembling sporotrichosis.

Mycelium 0.5-1.5μ in diameter, septate, little branched, tending to aggregate. Conidiophores erect, simple, with broad base but with slight constriction, 20-30μ, tapering as a long cone to a fine point, bearing, in a centripetal manner, indefinite heads of conidia which adhere in chains, are ovoid with unequal ends, 3-4 × 1.5-2μ, indefinite in number. In old cultures there are white, creamy formations which may be undeveloped perithecia. Spores brownish and terminated with a filiform papilla.

On Sabouraud maltose, growth attains a diameter of 1-1.5 cm. in 8 days, is round, flat, with indentations on the periphery. Central portion pure white, periphery gray like gray rubber. Finally, center becomes crateriform and the periphery develops radial folds. On glycerol agar slant, growth is more rapid, brighter, ivory in color, and with broader convolutions. On glycerol and potato, growth is good and about the color of the substrate with a surface of furry papillae, becoming snow white in the drier parts of the culture.

Scopulariopsis minimus Sartory, Hufschmitt & Meyer, Bull. Acad. Méd. III, **103**: 604-606, 1930.

Isolated from a case of onychomycosis.

Mycelium slender, 1.25-2.5μ in diameter, hyaline, branched. Conidiophores 10 × 1-2μ, often grouped in bundles. Phialides 3.75-4.5 × 1.25-1.5μ, sometimes in groups of two to three. Conidia spherical, apiculate, 1.25-1.5μ in diameter. Perithecia not found. Optimum temperature 28°-32° C.

Colony crateriform, small, white, after 21 days pale green, then deep green, then ashy with the margin remaining white.

Scopulariopsis ivorensis Boucher, Bull. Soc. Path. Exot. **11**: 308-321, 1918.

Several lesions over bony areas on each of 16 cases in Africa. Cured by medication with KI. Lesions reproduced on pigeon and guinea pig from each case encountered.

Hyphae septate with cells of metacarpal form, 1μ in diameter. Conidiophores short, irregular with long phialides. Conidia rounded or truncate, 6μ in long axis, brownish, echinulate, thick-walled. Live 5 months in culture. Gram-negative.

All cultures reported for 25° C. in diffuse light. On poor Sabouraud agar, growth powdery on the third day, chestnut on the fifth, deep brown on the seventh. On simple glucose agar on the third, colonies filamentous and rounded with central point refringent, browning on the fourth day, becoming powdery on the fifth and chestnut colored. Giant colony is 5 mm. in diameter on the second day, 1 cm. on the third day, central zone white and filamentous, outer hyaline and radiate, 5 cm. in diameter on seventh day, on eighth day whole colony becomes chestnut colored, on tenth dry and powdery, chestnut by reflected light, black filamentous by transmitted light; growth stops the twelfth day. If several inoculations have been made, colonies are not confluent. On potato, second day white, filamentous colonies, third day dry, light brown membrane with white border which spreads. Sixth day, culture wholly chestnut. On potato glycerol, second day culture white and dry, third day light brown, fourth day folded, fifth day powdery, medium covered on the eleventh day. Growth is slower in the dark. In glucose bouillon colony shows white clots on the surface the second day, on the fourth day a floating chestnut mat, elevated, with simple white border.

Scopulariopsis sputicola (Galippe) Dodge.

Monilia sputicola Galippe, Jour. de Anat. **21**: 538-553, *Pl. 27,* 1885.

Isolated from human sputum, perhaps as a contaminant in the author's attempt to secure sterile sputum by filtration.

Mycelium variable in diameter, branched, septate; phialides isolated or attached to a principal hypha. Conidia ellipsoid, in chains up to twenty-five, becoming long, echinulate, scabrous. Spores catenulate on side branches, end ones oldest, 3.7-7.5μ in short diameter, the mean measurements being 5.26 × 6.36μ.

Grows in white tufts of mycelium and white spores.

Scopulariopsis Castellanii Ota & Komaya, Derm. Woch. **78**: 163-165, 1924.

Isolated, probably as a contaminant, in a case of tinea flava. Mice killed in 14-16 days after intraperitoneal injection, and organism recovered from peritoneum, but pathogenicity mild or doubtful.

Hyphae about 5μ in diameter, with relatively thick septa, much branched. Fertile hyphae 3-4μ, unbranched or dichotomous. Conidiophore 2-40μ (sic), tips thickened; conidia spherical or ovoid, or roughly ovoid, 7-9μ, also subcitriform, echinulate.

Scopulariopsis Mencieri Dodge, n. sp.

Scopulariopsis sp. Sartory, Bull. Acad. Méd. **81**: 783, 784, 1919.

Found in pus from a war wound. Pathogenic to rabbit and guinea pig.

Mycelium hyaline, white, septate, sometimes narrowed at the septa, 2.5-3.6μ in diameter. Fertile hyphae in fascicles, sporophores 10-60μ, disposed regularly along a hypha, not isolated at first by a wall. Conidia in chains with the insertion characteristic of *Scopulariopsis,* 3-5μ in diameter, canary yellow, echinulate or nearly smooth. Optimum temperature 28°-30° C., maximum 40°-41° C.

Growth good on potato, carrot, Jerusalem artichoke, banana, agar, gelatin, ordinary Raulin and sugar broths. Only glucose and maltose are attacked, the latter hydrolyzed. Milk is coagulated the tenth day, and the coagulum peptonized. Gelatin liquefied in 5 days.

Scopulariopsis aureus Sartory, Champ. Parasit. Homme Anim. 680, 681, 1922.

Scopulariopsis sp. Sartory, C. R. Acad. Sci. **167**: 703, 704, 1919.

Found as a parasite on human nails.

On nails appears as irregular, septate hyphae, 2.5-9 or 10μ with terminal or intercalary chlamydospores, 20-35μ in diameter, occasional conidia. In culture mycelium white, then golden yellow. Hyphae 0.5-1.4μ in diameter, very much branched and having a tendency to aggregate conidiophores. Phialides erect, sometimes differentiated, tapering at the tip with spherical conidia, "*aureus,*" usually ornate, 3-4.5μ in diameter. On gelatin at 22°, conidia are sometimes smooth and hyaline, especially in old cultures. Chlamydospores sometimes intercalary and on maltose agar reach diameter of 130μ. Optimum temperature 29°-30° C., growth ceasing at 39° C.

Organism grows on Raulin maltose agar, potato, acid potato, glycerol potato, carrot, Sabouraud nutrient gelatin, Raulin's solution with sugars. No growth on egg albumen or coagulated beef serum, hence the latter not liquefied. Milk not coagulated in 40 days. Gelatin liquefied in 6 days.

Scopulariopsis brevicaulis (Saccardo) Bainier, var. **hominis** Brumpt & Langeron apud Brumpt, Précis Parasitol. ed. 2, 902-905, 1913.

Penicillium brevicaule Saccardo, var. *hominis* Brumpt & Langeron apud Brumpt, Précis Parasitol. ed. 1, 838-840, 1910.

Isolated from onychomycosis. In nails, mycelium septate, 2-10μ in diameter; chlamydospores both terminal and intercalary, 10-30μ. Weil & Gaudin (1919) report conidia in the nails. The parasitized portions of the nails are a dull yellow brown.

Hyphae on the surface of medium in tufts, aggregated, also in ropes; conidia café-au-lait, ornate, spherical to citriform.

Colonies on potato glycerol, sweet potato, carrot, Sabouraud's glucose and maltose agars, velvety.

Scopulariopsis venerei Greco, Origine des Tumeurs. 709-717, *Pl. 21, Figs. 437-440,* 1916.

Isolated from cases of venereal granuloma.

Mycelium abundant, septate, 2-5μ in diameter; chlamydospores(?) present; conidiophores short, 10-20μ long, arranged on main hyphae to give a verticillate appearance; phialides slightly conical or blunt; conidia 5-8 × 4μ with thick, outer wall spherical or citriform, with the surface showing yellowish refractive drops that give a rugose appearance.

Colonies slightly yellowish grayish chestnut to chestnut, with yellowish radiate spots, spreading, with whitish gray ropes at the center and in striae, margin light gray.

Scopulariopsis lingualis Neto & Martins, C. R. Soc. Biol. **106**: 1179-1181, 1931.

Isolated from lesions on human tongue, case not described here.

Mycelium slender, unbranched, septate, sometimes branching dichotomously at the tips. Conidiophores either simple, often reduced to a single conidium, or branched, each branch producing a single conidium. Conidia 1-2μ in diameter, spherical or ovoid.

On serum glucose, growth appears on third day, 1 cm. in diameter, on the eighth, irregular, velvety, rugose, slightly brownish. Same on carrot and maltose serum. On potato, growth slow and not characteristic. On Gorodkova agar, small colony, 3-4 mm. in diameter, yellowish, irregular, surface rugose apiculate, no tendency to spread over the surface. On gelatin, growth very slow, slight whitish membrane on twentieth day, no liquefaction. In Raulin's liquid, clear flocculent precipitate.

Scopulariopsis d'Agatae (Saccardo) Dodge, n. comb.

Oospora d'Agatae Saccardo apud d'Agata, Policlinico Sez. Chirurg. **25**: 80-87, *1 pl.,* 1918.

Sporendonema epizoum Ciferri & Redaelli, Jour. Trop. Med. Hyg. **37**: 167-170, 1934; Redaelli & Ciferri, Atti Ist. Bot. R. Univ. Pavia IV, **5**: 145-198, 1934.

Isolated from small, indolent nodules which become ulcers with blackish crust, 1.5 cm. in diameter. Nonpathogenic to guinea pigs, pathogenic to white rats; lesions similar to those produced by *Sporotrichum*. It is possible that some of the Italian cases referred to *Hemispora stellata* should be referred here. Cerri (1932) identifies this organism with *Torula Sacchari* Corda.

Hyphae septate, branched, 2.5-3μ in diameter, forming a mat 90-100μ thick; conidiophores erect 50-60μ high, densely fasciculate, flexuous, sparingly branched, 2.5-3.5μ in diameter, 50-60μ high at first, becoming 150-160μ, hyaline or subhyaline, minutely guttulate, sparingly septate, chains of conidia, 6-8 cells, developing slowly in the phialides and hanging together for a long time; conidia spherical 2.5-3.5μ smooth, uniguttulate, ochraceous at first becoming olivaceous; chlamydospores intercalary, hyaline, 8-10μ.

On Sabouraud glucose agar at 22° C., colonies grayish at first, becoming mammillate, grayish brown with brownish or chocolate powder, finally cerebriform and confluent. On glucose broth, chocolate brown, powdery, superficial, brown sediment but no true pellicle.

Doubtful Position

The following species are either too imperfectly described to place adequately or I have been unable to locate the original descriptions.

Scopulariopsis Vignolo-Lutatii (Matruchot) Dodge, n. comb.

Acaulium Vignoli-Lutatii Matruchot apud Vignolo-Lutati, Arch. Derm. Syphilis **118**: 681-698, *Pl. 21, 1 fig.*, 1913.

Isolated from lesions on skin following wound with acacia thorn, Novara Province, Italy. Lesions clinically suggest sporotrichosis or tuberculosis. Pathogenic for guinea pigs.

Mycelium of branched, hyaline, septate hyphae 2-3μ in diameter, not fasciculate. Phialides simple or in groups of two or three, 10-15 × 4μ; conidia in chains of 8-10, blackish brown.

Colony on Sabouraud glucose or maltose agar more or less cerebriform, center becoming very dark brown, outer zone yellow.

Scopulariopsis americanus Ota, Jap. Jour. Derm. Urol. **28**: 4:[7], 1928, nom. nud. [figured and perhaps described in the Japanese text]; Ota & Kawatsure, Arch. Derm. Syphilis **169**: 160-163, *Figs. 4-6,* 1933 [citing Ota, Jap. Jour. Derm. Urol. **26**: 1:111, 751, 1926, as place of original publication, but I have been unable to see this publication].

American oidiomycosis. Cultures of Weidman 1135, 1136, 1233, and 1234 (Ota collection 538, 539, 540, 541). Kawatsure (1933) reports pathogenicity for mice, white rats, guinea pigs, and rabbits.

Mycelium produces irregular arthrospores [suggesting those of *Madurella*]; conidia in chains of 3-4 spores on short side branches or more often singly, but never in typical phialides, smooth and hyaline at first, then cream yellow, verrucose, 5-6μ in diameter.

On peptone and peptone glucose agar, colony circular moist, cream gray, with radial folds, then producing numerous cervine coremia, becoming dull, dry with concentric rings of velvet, and finally powdery.

From the foregoing brief description it is evident that the species is not closely related to *Scopulariopsis* but is probably closely related to some of the species of *Zymonema*, although Kawatsuré's Fig. 6 Bh with its verrucose conidia is suggestive of *Hemispora*. As the description is based on four strains, which show some differences in pathogenicity and no reference is given to the case histories, it is not possible to place this organism definitely.

Scopulariopsis Fincki A. & R. Sartory, 1925; Vuillemin, Champ. Parasit. 65, 1931.

Scopulariopsis Mottai Vuillemin, Champ. Parasit. 62, 1931.

? *Pencillium epigaeum* Motta, Atti Clin. Ota-Rino-Laring. **25**: 305-322, 1927, non Berkeley & Curtis.

PHAEOSCOPULARIOPSIS

Phaeoscopulariopsis Ota, Jap. Jour. Derm. Urol. **28**: 4:[7], 1928.

Characters of *Scopulariopsis,* but spores brown to black, producing chains of spores on phialides.

Phaeoscopulariopsis Paisi (Pollacci) Ota, Jap. Jour. Derm. Urol. **28**: 4:[7], 1928.

Torula Pais Pollacci, Atti Ist. Bot. R. Univ. Pavia **18**: 129, 130, *Pl. 31,* 1921.

Found in axillary hair in Sassari.

Colony on glucose agar black, verrucose, with lanuginous margin. Hyphae sterile, sparsely septate, hyaline, and slender, with pale ochraceous and thicker tips, 4-6μ in diameter. Conidiophores short, sparingly septate, olivaceous, 4-12μ long. Conidia spherical, smooth, catenulate or glomerate, brown, 4-5μ in diameter.

Phaeoscopulariopsis Bestae (Pollacci) Ota, Jap. Jour. Derm. Urol. **28**: 4:[7], 1928.

Torula Bestae Pollacci, Riv. Biol. **4**: 313-318, *1 fig.,* 1922.

Isolated from subcutaneous abscesses in a patient suffering also from high fever, gastrointestinal disturbances, and bronchopulmonary trouble. On lancing, the lesions produced bloody, purulent matter. Similar smaller foci of infection developed. *Trichosporium Mantegazzae* also isolated from the same lesions.

Sterile hyphae repent, branched, filiform, pale at first then rosy or pale avellaneous, 5-6.5μ in diameter. Conidiophores short, septate, scarcely distinct from sterile hyphae, 6-20μ long, apex rounded. Mature conidia spherical, smooth, rose colored at first, then avellaneous, 8-10μ in diameter, shortly catenulate.

On glucose agar, 15°-20° C., colony circular, pale at first, floccose, then covering the medium, rose with more or less white margin, ragged, then avellaneous; not liquefying gelatin.

ALLESCHERIA

Allescheria Saccardo & Sydow, Syll. Fung. **14**: 464, 1899.

Eurotiopsis Costantin, Ann. Inst. Pasteur **11**: 1-43, 1897, non Karsten, 1889.

Eurotiella Lindau in Engler & Prantl, Die Naturl. Pflanzenfam. I, **1**: **: 383, 1900.

The type species is *Eurotiopsis Gayoni* Costantin.

Perithecia spherical, minute, thin-walled; asci spherical, ascospores ovoid, pointed at the ends. Conidia in chains at the tips of sporophores but compressed as in *Cephalosporium.*

So far known only from a single case of mycetoma, with white grains.

Allescheria Boydii Shear apud Boyd & Crutchfield, Amer. Jour. Trop. Med. **1**: 258-268, 1921; Mycologia **14**: 242, *Figs. 1-3,* 1922.

Isolated from the foot of a male negro farm laborer in Texas. Thorn in foot near metatarsophalangeal articulation twelve years before. Thorn removed and wound healed. Three months later patient felt a stinging pain in the ankle, followed by swelling. At intervals soft openings appeared in the side of the ankle which discharged pus and healed in a few weeks. Process has not extended, remaining localized for many years and showing white grains. Ankle swells when patient is on his feet long.

Perithecia numerous, crowded, covering the surface of the medium, usually erumpent or subsuperficial, spherical, thin-walled, dark brown, astomatous, 100-200μ in diameter; asci spherical or subspheric, thin-walled, evanescent at maturity, 10-20μ in diameter; no paraphyses; ascospores 8, spherical to subspheric or somewhat ovoid, continuous, smooth, pale yellowish brown when mature, spherical form about 7μ in diameter, other mostly 5.5-7 × 4-4.5μ.

Pycnidia wanting or unknown.

Cephalosporium Boydii, byssoid, thin, floccose, white at first, soon gray, margin radiate-fimbriate, later changing to pale greenish ochraceous as sporulation begins, fertile hyphae much branched, spreading, conidia adhering in small or large subspheric masses, continuous, subspheric to oblong ellipsoid, very variable in size and shape, hyaline at first, becoming pale, yellowish brown when old, smooth, 8-15 × 4-7.5μ, mostly 10-12 × 5-6μ.

Coremia *(Dendrostilbella Boydii)* with dark brown synnema very variable in height and thickness, 200-300μ or more high, head subspheric; conidiophore alternately branching, ultimate branches once or twice the length of the conidia; conidia practically the same size, shape, and color as in the byssoid condition and adhering in a globular mass after abstriction.

Organism was cultivated from granules on plain, Sabouraud, Huntoon, and glucose agar. No bacteria found. Huntoon's agar is best. In 14 days, colony 5 cm. across with four zones, center 3 mm. with alternate light gray and darker brownish gray bands with smaller, dark coremia. On Sabouraud agar, colonies smaller and zoning less noticeable, pale grayish green with white border. No fructifications seen. Perithecia formed on Sabouraud agar and potato, 200μ in diameter. Perithecia cespitose on potato glycerol. Organism is strongly aerobic, showing very little growth in liquid media, but a good pellicle is formed. Carbohydrates not fermented. Milk and Loeffler's serum are peptonized. Blood not hemolyzed but in agar, gradually becomes green. Gelatin liquefied.

ONYGENACEAE

The members of this family are saprophytic but confined to animal substances, such as hoofs, horns, claws, feathers, etc. They are included here, since it is possible that eventually some members may be found parasitic. When the family is studied more fully, it is possible that it may show resemblances to the dermatophytes, *Achorion,* or to some genera of Aspergillaceae which seem to show some specialization on nails, e.g., *Scopulariopsis.*

Onygena equina is the only species studied carefully. The fructifications are up to 1 cm. in height. They consist of solid homogeneous coremia which abjoint, on their surfaces, so many chlamydospores that they seem to be covered with a brown powder. Later each is differentiated into a solid stipe, composed of parallel hyphae and a somewhat looser head, consisting of radiating hyphae. On the outer surface of the head, the hyphae intertwine to form a firm, pseudoparenchymatous peridium. The interior hyphae develop into capillitium and aid in the dissemination of spores.

Nothing is known of the cytology of this species. Within the head in various places, two short, septate branches coil about each other into a solid knot. At maturity, the cavity of the head is filled by a dark spore mass through which run the capillitium threads, generally starting at the base. The peridium is ruptured irregularly, or around the base of the head, and the spores are scattered. They germinate after a resting period, which may be shortened by placing the spores in a mixture of HCl and pepsin, similar to that in the gastric juice. Immature ascospores and chlamydospores germinate without this stimulation (Ward 1899; Brierley 1917).

BIBLIOGRAPHY

Abrikossoff, A. 1929. Über Splenomykosen und mykotische Splenomegalien, *Arch. Path. Anat. Phys.* [Virchow] 272: 593-612, *16 figs.*

Agostini, Angela. 1930. Dermatomicosi dovuta a Eurotium rubrum Bremer, *Atti Ist. Bot. R. Univ. Pavia* IV, 2: 65-79, *5 figs.*

Aimé, Paul Pierre Creuze & Hubert Kresser. 1933. Mycose pulmonaire à Penicillium crustaceum, avec signes cliniques et aspect radiologique d'abcès du poumon, *Presse Méd.* 41: 761-763, *5 figs.*

Anderson, C. 1925. Sur un cas d'otomycose à Sterigmatocystis nigra, *Arch. Inst. Pasteur Tunis* 14: 93-96.

Aresu, Mario & Giuseppe Lino. 1924. Nuova forma di micosi cutanea del piede da Sterigmatocystis nigra (Cramer), *Ann. Clin. Med. e di Med. Sperim.* **13:** 358-382, *5 figs.*

Askanazy, M. & A. Schweizer. 1927. Über (sidero-) mykotische Splenomegalie, *Schweiz. Med. Woch.* **57:** 777-779, *2 figs.*

Bailly, Paul. 1922. Contribution à l'étude de l'action de quelques terres rares sur l'Aspergillus fumigatus Fr., *Thèse Univ. Strasbourg Fac. Pharmacie.* **11:** 1-46, *Pl. 1, 2.*

Bainier, G. 1880. Sterigmatocystis et Nematogonum, *Bull. Soc. Bot. France* **27:** 27-32, *Pl. 1.*

Bainier, G. & Antoine Sartory. 1909. Étude d'un Aspergillus pathogène (Aspergillus fumigatoides nov. sp.), *Bull. Soc. Myc. France* **25:** 111-118, *Pl. 5* [*C. R. Soc. Biol.* **66:** 22, 23, 1909].

Ballin, 1908. Das Schicksal inhalierter Schimmelpilzsporen. Ein Beitrag zur Kenntnis des Infektionsweges durch Inhalation, *Zeitschr. Hyg.* **60:** 479-489.

Bellucci, Luigi. 1925. Di alcuni importanti reperti micotici in otorinolaringologia (Acremonium tonsillare—Ozena nasala—Otite media da Sterigmatocystis ochracea), *Atti R. Accad. Fisiocrit. Siena* IX, **17:** 17-43, *16 figs.* [same title, *Arch. Ital. Otol.* **37:** 1-21, *3 pls.*, 1926].

Bendixen, H., Christian & N. Plum. 1929. Schimmelpilze (Aspergillus fumigatus und Absidia ramosa) als Abortusursache beim Rinde, *Acta. Path. Microbiol. Scand.* **6:** 252-322, *6 figs.*

*Bergeon. 1929. À propos de trois cas d'aspergillose animale, *Bull. Soc. Méd.-Chirurg. Indochine.* **7:** 116-121.

Bergman, Rolf & Folke Henschen. 1930. Zur Kasuistik der Lungenaspergillose, *Beitr. Klin. Tuberk.* **73:** 467-484, *8 figs.*

Berliner, Lippmann. 1882. Ein Fall von Hypopyon keratis durch Schimmelpilze, *Inaug. Diss. Berlin*, 30 pp.

Bernton, Harry S. 1930. Asthma due to a mold—Aspergillus fumigatus, *Jour. Am. Med. Ass.* **95:** 189, 190.

Bernton, Harry S. & Charles Thom. 1933. The importance of molds as allergic excitants in some cases of vasomotor rhinitis, *Jour. Allergy* **4:** 114-122.

Bertaccini, Giuseppe. 1934. Contributo allo studio della cosidetta Blastomicosi sudamericanna, *Giorn. Ital. Derm. Sifilol.* **75:** 783-828, *Pls. 1-9.*

Berti, Giuseppe. 1921. Contributo sui granulomi sperimentali provocati da una Oospora patogena (Oospora D'Agatae Sacc. n. sp.), *Riv. Biol.* **3:** 165-171, *2 figs.*

Besta, Carlo. 1905. Sopra il potere patogeno dell'Aspergillus fumigatus, Ricerche sperimentali, *Arch. Ital. Mal. Nerv. Mentali.* **42:** 502-517, *Pl. 8* [*Riv. Sperim. Freniatria Med. Leg.* **31.**]

Bezold. 1873. Die Entsehrung von Pilzbildung im Ohre, *Monatschr. Ohrenheilk.* **7:** col. 81-92.

Blanc, Georges & L. Caillou. 1924. Sur une mycose aspergillaire observée en Tunisie, *Bull. Soc. Path. Exot.* **17:** 343-345, *1 fig.*

Blanchard, Raphael. 1906. Sur un cas de mycétome d'origine aspergillaire observé en Tunisie par les Drs. Nicolle et Brunswic-le-Bihan [Rap], *Bull. Acad. Méd.* (Paris) III, **55:** 132-135.

Bloch, Bruno & Ad. Vischer. 1911. Die Kladiose, eine durch einen bisher nicht bekannten Pilz (Mastigocladium) hervorgerufene Dermatomykose, *Arch. Derm. Syphilis* **108:** 477-512, *Pls. 19-21.*

Blochwitz, Adalbert. 1932. Perithecien, Sklerotien und Eidamsche Blasen der Aspergillaceen. Vorkommen Bedingungen systematischer Wert, *Beih. Bot. Zentralbl.* **49:** 262-292.

—. 1932. Die Urformen der Aspergilleen, *Hedwigia* **72:** 173, 174.

Block, Alwin Rudolf Arthur. 1870. Beiträge zur Kenntniss der Pilzbildung in den Geweben des thierischen Organismus, *Inaug. Diss. Univ. Greifswald* 36 pp., *1 pl.*

Blumentritt, Fritz. 1901. Über einen neuen, in Menschen gefundenen Aspergillus (A. bronchialis) n. sp., *Ber. Deutsch. Bot. Ges.* **19:** 442-446, *Pl. 22.*

Bodin, Eugène & Pierre Savouré. 1904. Recherches expérimentales sur les mycoses internes, *Arch. de Parasitol.* 8: 110-136.

Bolognesi, Giuseppe. 1923. Micosi chirurgiche sperimentali, *Pathologica* 15: 374, 375, *2 figs.*

Boucher, Humbert. 1918. Mycoses gommeuses de la Côte d'Ivoire, *Bull. Soc. Path. Exot.* 11: 306-338.

Bournay, J. 1895. Pneumomycose aspergillaire chez une vache, *Rev. Vét. Toulouse* 20: 121-128.

Bovo, Paolo. 1906. Micosi del piede da Aspergillo, *Policlinico, Sez. Chirurg.* 13: 97-119, *6 figs.*

Bresciani, Giovanni. 1924. Sull virulentazione dei miceti (note prima), *Riv. Biol.* 6: 310-322.

Burnett, Charles H. 1878. The growth of the fungus Aspergillus in the human ear, *Philadelphia Med. Times* 8: 435-440, *3 figs.*

Burnett, Swan M. 1881. Otomyces purpureus (Wreden) in the human ear, *Arch. of Otology* 10: 319-326.

Buscino, Armando & Antonio Cardia. 1929. Su una dermatomicosi umana da Penicillium minimum Siebenmann, *Arch. Ital. Chirurg.* 24: 118-141.

Canio, Russo. 1918. Pseudo-tuberculose clinique et expérimentale à Penicillum glacum, *Jour. Méd. Bordeaux* 47: 162-166.

Cartia, Batolomeo. 1930. Un caso di micetoma dei piedi da Aspergillus niger con aspergillidi delle mani, *Giorn. Ital. Derm. Sifilol.* 71: 638-651, *Pls. 1, 2;* 1016-1018.

Castrillon, Basilio A. & Ernesto P. Borsaui. 1925. Micosis aspergilar, *Semana Méd.* 32: 924-926.

Cavallucci, Ugo. 1930. Sull'Aspergillosi cutanea, contributo anatomoclinico e sperimentale, *Giorn. Ital. Derm. Sifilol.* 71: 1673-1684, *1 pl.*

Ceni, Carlo. 1905. Potere patogeno dell'Aspergillus ochraceus e suo rapporto coll'etiologia e patogenesi della pellagra, *Arch. Ital. Mal. Nerv. Mentali.* 42: 231-244, *Pl. 6.* [*Riv. Sperim. Freniatria* 31]

—. 1905. Di una nuova specie di Aspergillus varians e delle sue proprietà patogene in rapporto coll'etiologia della pellagra, *Arch. Ital. Mal. Nerv. Ment.* 42: 595-617, *Pl. 11.* [*Riv. Sperim. Freniatria* 31.]

Ceni, Carlo & Carlo Besta. 1905. Sclerosi in placche sperimentale da tossica aspergillari, *Arch. Ital. Mal. Nerv. Mentali.* 42: 125-134, *Pls. 2, 3.* [*Riv. Sperim. Freniatria* 31]

—. 1905. Sulla persistenza del potere vitale e patogeno della spora aspergillare nell'organismo animale. Contributo sperimentale alla recidività della pellagra, *Arch. Ital. Mal. Nerv. Mentali.* 42: 496-501. [*Riv. Sperim. Freniatria* 31.]

Cerri, Laura. 1932. L'Oospora d'Agatae Sacc. e sinonims di Torula Sacchari Corda, *Atti Ist. Bot. R. Univ. Paris* IV, 3: 167-173.

Chable, Robert. 1917. Über die pathogene Wirkung des Aspergillus fumigatus in der Subkutis des Meerschweinschens, *Arch. Derm. Syphilis* 124: 14-46, *1 pl.* [*Centralbl. Bakt.* 68: 201-228]

Chantemesse. 1891. Eine mykotische Pseudotuberculose, *Centralbl. Bakt. Ref.* 9: 775, 776.

Chisholm, Julian J. & Alan C. Sutton. 1925. Otomycosis, a report of nine cases treated with KI, *Arch. Otolaryngol.* 2: 543-556.

Chiurco, Giorgio Alberto. 1924. Sopra un caso di micosi polmonare da Aspergillus fumigatus, *Pathologica.* 16: 510-512.

—. 1924. Sopra un caso di osteoperiostite della mandibola da Sterigmatocystis nidulans Eidam, *Atti R. Accad. Fisiocrit. Siena* IX, 16: 23-29.

Church, Margaret B. & John S. Buckley. 1923. Laboratory feeding of molds to animals, *N. Amer. Vet.* 4: 7-13.

Cleland, J. Burton. 1924. Aspergillosis of the pleura with sclerotium formation, *Med. Jour. Australia,* 2 pp.

Coccheri, P. 1929. Micosi pulmonare da Sterigmatocystis nigra van Tieghem, *Atti Ist. Bot. R. Univ. Pavia* IV, 1: 161-181, *8 figs.*

Corpaci, Alessandro. 1925. Reazioni immunitarie nelle aspergillosi, *Boll. Ist. Sieroterapico Milanese* 4: 295-306.

Costantin, J. & A. Lucet. 1905. Recherches sur quelques Aspergillus pathogènes, *Ann. Sci. Nat. Bot.* IX, 2: 119-171.

Costantin, J., E. Pinoy & A. Nanta. 1927. À propos de l'étiologie et du traitement de certains splenomegalies parasitaires, *Bull. Mém. Soc. Nat. Chirurg.* 53: 783-789.

Cramer, Carl. 1859. Über eine neue Fadenpilzgattung: Sterigmatocystis Cramer. *Vierteljahrschr. Naturf. Ges. Zürich* 4: 325-337, *Pl. 2.*

Crookshank, F. G. 1928. Splenomegaly associated with aspergillosis, *Lancet* 214: 933.

Curzi, Mario. 1931. Rapporti fra i generi Microascus Zukal e Scopulariopsis Bainier, *Soc. Internaz. Microbiol. Sez. Ital.* 9: 52-57.

D'Agata, Giuseppe. 1918. Su di un caso di micosi dovuto ad una nuova specie di Oospora (Oospora d'Agatae Sacc. n. sp.), *Policlinico, Sez. Chirurg.* 25: 80-87, *1 pl.*

—. 1925. Ricerche e osservazioni su un caso non comune di actinomicosi dell'avambraccio, *Policlinico, Sez. Chirurg.* 32: 31-39, *1 pl.* [Congr. Ital. Chirurg. 1924]

Delépine. 1891. Melanomycose cutanée, *Semaine Méd.* 11: 199.

Dessy, G. 1932. La chémiothérapie des mycoses. I, Aspergillose. Expériences in vivo, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 4: 113-118, II, Penicillose, *Ibid.* 4: 119-126.

Devillers, Louis & Louis Rénon. 1899. Bronchite membraneuse chronique aspergillaire primitive, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 16: 902-912.

*Dick, J. A. 1892. A case of parasitic disease of the pharynx, Aspergillus, *Intercolonial Med. Cong. Australasia 3rd. Sess. Melbourne,* 482.

Dieulafoy, Chantemesse & Widal. 1890. Pseudotuberculose mycosique des gaveurs de volaille, *Bull. Méd.* 4: 748.

Dodge, Bernard O. 1933. The perithecium and ascus of Penicillium, *Mycologia* 25: 90-104, *Pls. 18, 19, 2 figs.*

Drygalski, Ruth von. 1933. Aspergillusmykose der menschlichen Lunge. *Inaug. Diss. Med. Fak. Univ. München,* 28 pp.

Dusch, von & A. Pagenstecher. 1857. Fall von Pneumomycosis Aspergillus pulmonum hominis, *Arch. Path. Anat. Phys.* [Virchow] 11: 561-566.

Ellis, David. 1933. The incidence of asthma in Port Sudan with special reference to the influence of molds, *Guy's Hosp. Repts.* 83: 102-111.

Emerson, Charles P. 1921. Penicillium lung infection, *Trans. Ass. Amer. Physicians* 36: 18-33.

Emmons, C. W. & Bernard O. Dodge. 1931. The ascocarpic stage of species of Scopulariopsis, *Mycologia* 23: 313-331, *Pls. 25-28.*

Ernst, Paul. 1894. Über eine Nierenmykose und das gleichseitige Vorkommen verschiedener Pilzformen bei Diabetes, *Arch. Path. Anat. Phys.* [Virchow] 137: 486-538.

Escomel, Edmundo. 1931. À propos des Kcara, Pinta ou Caratès dans le sud du Pérou, *Bull. Soc. Path. Exot.* 24: 215-222.

—. 1932. Micosis cutánea con despigmentación producida en el Telmatobius, *Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán* 7: 227-232, *3 figs.*

Esser, A. 1925. Ein Fall primärer Aspergillusgangrän der menschlichen Respirationsapparat, *Arch. Path. Anat. Physiol.* [Virchow] 257: 4-14.

Falkenheim, Jr. 1882. [Case history.] *Berlin. Klin. Woch.* 19: 754.

Fleck, Ludwig. 1930. Ein Fall von Pseudosyphiloma anorectale mykotischer Ätiologie (Kladiosis), *Derm. Woch.* 90: 379-382, *3 figs.*

Foerster, O. H. & K. L. Puestow. 1927. Maduromycosis (due to Aspergillus nidulans), *Arch. Derm. Syphilol.* 16: 91-93.

Fonseca, Olympio Oliveiro Ribeyro da. (filho). 1930. Mycetoma por ''Aspergillus Amstelodami,'' *Rev. Med.-Cir. Brasil* 38: 415-430, *Pl. 1,* [1-19].

—. 1929. Contribuição para o estudo da acção pathogenica dos cogumelos do grupo do Aspergillus glaucus: um novo typo de mycetoma aspergillar, *Revista das Clinicas* 1-6. [*Rev. Brasil Med.* 43: 504, 1929.]

Fonseca, Olympio da & A. E. de Arêa Leão. 1928. A questão das esplenomeglias mycosicas, *Mem. Inst. Oswaldo Cruz. Suppl.* 11: 10-22.

Fox, Howard. 1928. Carate (Pinta) as observed in Colombia, South America, *Arch. Derm. Syphilol.* 18: 673-691, *9 figs.*

Frank. 1890. [Aspergillus fumigatus, Mucor racemosus], *Deutsche Zeitschr. Thiermed. Vergl. Path.* 16: 296, 297.

Frank, Louis & O. M. Alton. 1933. Aspergillosis, a case of postoperative skin infection. *Jour. Am. Med. Ass.* 100: 2007, 2008, *1 fig.*

Friedenreich, N. 1856. Fall von Pneumomycosis Aspergillina, *Arch. Path. Anat. Phys.* [Virchow] 10: 510-512, *Pl. 6, Fig. 5.*

Froilano de Mello, Indalencio. 1932. Sur une nouvelle espèce de Scopulariopsis trouvée aux Indes portugaises, *Bull. Soc. Path. Exot.* 25: 295, 296.

Fuchs, Ernst. 1894. Keratomycosis Aspergillina, *Wien. Klin. Woch.* 7: 305-307.

Gamna, Carlo. 1927. Sur la clinique et l'étiologie de la splénogranulomatose siderosique, *Le Sang.* 1: 610-633, *1 pl., 2 figs.*

—. 1928. À propos de mycose splénique, *Presse Méd.* 36: 357.

Gardey, F. 1923. Aspergilosis polmonar, *Semana Méd.* 1: 390.

Gaucher, E. & Emile Sergent. 1894. Un cas de pseudotuberculose aspergillaire simple chez un gaveur de pigeons, *Bull. Soc. Méd. Hôp. Paris* III, 11: 512-521.

Gauducheau, A. 1910. Pseudo-tuberculoses mycosiques observées chez des chinois à Canton, *Bull. Soc. Path. Exot.* 3: 488-490.

Gibson, A. G. 1930. The mycoses of the spleen. London; Kegan Paul, Trench Trubner & Co. 169 pp., *10 pls.*

Gilbert, G. Burton. 1922. Report of a few unusual lung infections, *Southwestern Med.* 6: 43-46, *4 pls.*

*Giordano, M. 1919. Un caso di micosi pulmonare da Penicillium glaucum, *Ann. Med. Nav. Colon.* 24: 567.

Gluge, Gottlieb & J. d'Ukedem. 1857. De quelques parasites végétaux dévéloppés sur des animaux vivants, *Bull. Acad. R. Belgique* II, 3: 338-352, *Pls. 1, 2.*

Goinard, Pierre. 1927. Sur certains splénomégalies algériennes, *Thèse Alger.* 236 pp.

Gosset, A., I. Bertrand & J. Magrou. 1928. Recherches expérimentales sur l'aspergillose splénique, *C. R. Soc. Biol.* 98: 769, 770.

Gotti, A. 1871. Otomicosi nel cane, *Giorn. Anat. Fisiol. Patol. Anim.* [3]: 100-102.

Gouzartchik-Glarner, V. 1931. Étude biologique d'une souche d'Aspergillus fumigatus isolé des crachats d'une malade, *C. R. Soc. Biol.* 108: 374-376.

Green, John Orne. 1868. A parasitic growth in the external auditory meatus, *Boston Med. Surg. Jour.* 79: 241-243.

—. 1869. Two cases of parasitic growth (Aspergillus glaucus) in the external auditory meatus, *Trans. Am. Otol. Soc.* 1: 23-26.

—. 1870. Case of Aspergillus in the external auditory meatus, *Trans. Am. Otol. Soc.* 1: 79, 80.

Greggio, Ettore. 1914. Sur l'aspergillose expérimentale, *Rev. Path. Comp.* 14: 196-207, *6 figs.*

Grijns, G. 1903. Die Ascusform des Aspergillus fumigatus, *Centralbl. Bakt.* II, 11: 330-332, *6 figs.*

Guéguen, Fernand. 1909. Aspergillus Fontoynonti nova sp., parasite probable des nodosités juxta-articulaires, *C. R. Soc. Biol.* 66: 1052, 1053, 1909; also 67: 10-12, 1909.

—. 1911. Abcès sous-dermiques à répétition produits par l'Aspergillus Fontoynonti n. sp., morphologie et biologie de cette espèce, *Arch. Parasitol.* 14: 177-192.

Hagen, R. 1869. Ein neuer Ohrpilz (Otomyces Hageni) ausgefunden von Dr. Hagen in Leipzig und untersucht von Professor Hallier in Jena, *Zeitschr. Parasitenk.* **1**: 195-198. [Hallier, Ernst. Notiz zu vorstehender Arbeit über den neuen Ohrpilz: Otomyces Hageni, *Zeitschr. Parasitenk.* **1**: 199-202.]

—. 1869. Zwei weitere Fälle von Ohrpilze, *Zeitschr. Parasitenk.* **1**: 368-374. [Hallier, Ernst. Vorläufige Notiz zu vorstehender Arbeit, *Ibid.* **1**: 375.]

—. 1870. Weitere Fälle von Pilzkrankheiten des Ohres, *Zeitschr. Parasitenk.* **2**: 22-29.

Hallier, Ernst. 1870. Mittheilung über die Ohrpilze, welche Herr Dr. R. Hagen in Leipzig zur mikroscopischen Untersuchungen Einsandte, *Zeitschr. Parasitenk.* **2**: 259-284, *Pls. 5, 6.*

Halbertsma, Eeltje Hiddes. 1888. Hypopion Keratitis door enting von Aspergillus flavescens, *Proefschrift. Univ. Utrecht.* 70 pp., *1 pl.*

Hansen. 1928. Über Schimmelpilz-Asthma, *Verhandl. Deutsch. Ges. Inn. Med.* **40**: 204-206.

Harmer, Douglas & T. Jockes. 1919. Specimens of Aspergillus fumigatus from nasal sinuses, *Proc. R. Soc. Med.* [London] **12**: Laryngology: 187, 188.

Hatch, W. K. & R. Row. 1900. Fungus disease of the ear, *Lancet* **2**: 1561-1564.

Heider, Adolf. 1890. Über das Verhalten der Ascosporen von Aspergillus nidulans Eidam in Thierkörper, *Centralbl. Bakt.* **7**: 553-566.

Hellens, O. von. 1905. Zur Kenntnis der durch Aspergillus fumigatus in den Lungen hervorgerufenen Veränderungen, *Arb. Path. Inst. Univ. Helsingfors* **1**: 313-343.

Hochheim, K. 1902. Ein Beitrag zur Kasuistik der Pneumonomykose aspergillina, *Arch. Path. Anat. Physiol.* [Virchow] **169**: 163-183.

Hodara, Menahem & Houloussi Behdjet. 1925. Ein Fall von Hautaspergillose der linken Wange, *Derm. Woch.* **80**: 476-479, *2 figs.*

Hu, C. H., Hobart A. Reimann & Timothy J. Kurotchkin. 1929. Filaments in siderotic nodules of the spleen in cases of splenomegaly of unknown origin, *Proc. Soc. Exp. Biol. Med.* **26**: 413-416.

Hügemeyer, Otto. 1888. Ueber Abschwachung pathogene Schimmelpilze, *Inaug. Diss. Rheinisch Friedrich-Wilhelms Univ. Bonn*, 30 pp.

Jager, L. de. 1911. Een geval van pneumonomykosis aspergillina, *Nederl. Tijdschr. Geneesk.* **2**: 866-869, *1 fig.*

Jannin, Louis. 1912. Mycoses gommeuses à Scopulariopsis Koningi, *Arch. de Parasitol.* **15**: 478-489, *1 pl.*

Johan-Olsen [Sopp], O. & F. G. Gade. 1886. Undersøgelser over Aspergillus subfuscus som patogen mugsop, *Nord. Med. Arkiv.* **18**: 9: 1-54, *Pls. 1, 2.*

Karrenberg, C. L. 1929. Primäre Hautaspergillose als Komplication bei einem an Mikrosporie erkrankten Kinde (zugleich Bemerkungen über Vorkommen und Pathogenität der Spezies Aspergillus flavus Brefeld), *Derm. Woch.* **88**: 89-95, 125-129, *4 figs.*

Kawatsure, Shûji. 1933. Tierexperimentelle Untersuchungen über die Erreger von sogenannten amerikanischen Blastomykosen: Scopulariopsis americana, Aleurisma tulanense und Coccidioides immitis, *Arch. Derm. Syphilis* **169**: 173-199, *11 figs.*

Keller, Ph. 1928. Epidermale Aspergillusmykose der Haut, *Derm. Woch.* **87**: 1831-1833.

Klosterkemper, Heinrich. 1893. Beiträge zur Kenntniss der Lungenmykose der Säugethiere, *Inaug. Diss. Giessen*, 42 pp.

Kohn, H. 1893. Ein Fall von Pneumomycosis aspergillina, *Deutsch. Med. Woch.* **19**: 1332, 1333.

Kotliar, E. 1894. Contribution à l'étude de la pseudotuberculose aspergillaire, *Ann. Inst. Pasteur* **8**: 479-489.

Landrieu, Marcel. 1912. Les mycoses oculaires, *Thèse de Paris*, 136 pp.

Lang, F. J. & F. Grubauer. 1923. Über Mucor- und Aspergillus-mykose der Lunge, *Arch. Path. Anat. Phys.* [Virchow] **245**: 480-512, *17 figs.*

Langeron, Maurice. 1922. Sur un champignon d'une otomycose brésilienne Sterigmatocystis Hortai, *Bull. Soc. Path. Exot.* **15**: 383, 384.

—. 1922. Utilité des deux nouvelles coupures génériques dans les Perisporiacées: Diplostephanus n.g. et Carpenteles n.g., *C. R. Soc. Biol.* **87**: 343-345.

—. 1924. Un Sterigmatocystis nouveau, parasite de l'homme en Tunisie, S. tunetana n. sp., *Bull. Soc. Path. Exot.* 17: 345-347, *1 fig.*

—. 1928. Les prétendus mycoses de la rate, *Ann. Parasitol. Hum. Comp.* 6: 211-220.

Lapham, Mary E. 1926. Aspergillosis of the lungs and its association with tuberculosis, *Jour. Am. Med. Ass.* **87**: 1031, 1032.

Leber, Th. 1879. Keratomycosis aspergillina als Ursache von Hypopyonkeratitis, *Arch. Ophthalm.* [Graefe] II, **25**: 285-301.

—. 1882. Über die Wachstumsbedingungen der Schimmelpilze in menschlichen und tierischen Körper, *Berlin. Klin. Woch.* **19**: 161-164.

Leger, Marcel & Maurice Nogue. 1922. Mycose à Scopulariopsis chez deux malades ayant des lésions cutanées rappelant la lèpre, *Bull. Soc. Path. Exot.* **15**: 654-661.

Lesage, Pierre. 1899. De la possibilité de quelques mycoses dans la cavité respiratoire basée sur l'hygrométrie de cette cavité, *Thèse Méd. Paris* 23: 63 pp.

—. 1902. Germination des spores de champignon chez l'homme, *C. R. Ass. Franç. Av. Sci* [Congrès de Montauban] **1902**: 2: 723-727.

—. 1904. Contribution à l'étude des mycoses dans les voies respiratoires, rôle du régime hygrométrique dans la génèse de ces mycoses, *Arch. de Parasitol.* 8: 352-443.

Leszczyński, Roman v. & Roman Epler. 1926. Zur primären Hautaspergillose, *Derm. Woch.* **82**: 181-189.

Lewis, P. M. 1927. Otomycosis, a report of three cases, *Jour. Am. Med. Ass.* 89: 112.

Lichtheim, L. 1882. Über pathogene Schimmelpilze I. Die Aspergillusmykosen, *Berlin. Klin. Woch.* **19**: 129-132, 147-152.

Lindt, Wilhelm. 1886. Mittheilungen über einige neue pathogene Schimmelpilze, *Arch. Exp. Path. Pharm.* **21**: 269-298.

—. 1889. Über einem pathogenen Schimmelpilze aus dem menschlichen Gehörgang, *Arch. Exp. Path.* **25**: 257-271, *11 figs.*

Lucet, Adrien. 1894. Études cliniques et expérimentales sur l'Aspergillus fumigatus, *Bull. Soc. Centr. Méd. Vét.* **48**: 387-398 [N. S. 12].

—. 1896. Étude expérimentale et clinique sur l'Aspergillus fumigatus pour faire suite au memoire du même auteur recompensé par la société en 1894, *Bull. Soc. Centr. Méd. Vét.* **50**: 575-614.

—. 1897. L'Aspergillus fumigatus chez les animaux domestiques et dans les oeufs en incubation. Étude clinique et expérimentale. Ch. Mendel, Paris, 108 pp., 14 microphotographs.

Luksch, Franz. 1902. Vegetation eines bisher noch nicht bekannt gewesenen Aspergillus im Bronchialbaume eines Diabetikers, *Zeitschr. Heilk.* II, **23**: 153-170, *Pl. 15.*

Lynch, K. M. 1923. Aspergillus in scalp lesions following redbug (Leptus) bites, *Arch. Derm. Syphilol.* 7: 599-602.

Mackenzie, John N. 1893. Preliminary report on Aspergillus mycosis of the antrum maxillare, *Johns Hopkins Hosp. Bull.* 4: 9, 10.

—. 1894. Aspergillus mycosis of the antrum maxillare, *New York Med. Jour.* 60: 238-240.

Mackinnon, Juan E. 1932. Observaciones sobre algunos hongos del género Aspergillus Micheli, *Arch. Soc. Biol. Montevideo* 4: [1-4].

Macé, Th. Ch. 1903. Étude sur les mycoses expérimentales (aspergillose et saccharomycose), *Arch. de Parasitol.* 7: 313-370.

Manrique, Juan E. & J. B. Montoya y Flores. 1899. Commentarios sobre el historico de los carates, *Arch. de Parasitol.* 2: 596-605.

Mantelli, C. & G. Negri. 1915. Ricerche sperimentali sull 'agente eziologico di un micetoma a grani neri (Penicillium mycetogenum n.f.), *Giorn. R. Accad. Med. Torino* [IV, 21?] 78: 161-167.

Matruchot, L. 1911. Un nouveau champignon pathogène pour l'homme, *C. R. Acad. Sci.* **152**: 325-327.

Matsumoto, Takahashi. 1929. The investigation of aspergilli by serological methods, *Trans. Brit. Myc. Soc.* 14: 69-88.

Matta, Alfredo da. 1928. Sterigmatocystis tropicalis n. sp. de fungo patogenico para o homen, *Bol. Inst. Brasil. Sci.* 3: 51-54, *1 pl.*

Mattlet, G. 1924. Bronchomycoses dues à des Serigmatocystis dans l'Urundi. Communication préliminaire, *Ann. Soc. Belge Méd. Trop.* 4: 167-176, *3 figs.*

Mayer. 1844. Cysten mit Fadenpilze aus dem äussern Gehörgange eines Mädchens, *Arch. Anat. Phys. Wiss. Med.* [Müller] 1844: 404-408.

Meineri, Pier-Angelo. 1921. Contributo allo studio del potere patogeno del "Penicillium glaucum" sulla cute umana, *Pathologica* 13: 511-513.

Meis, Vincenzo de & Carlo Parascandolo. 1895. Su di una nuova forma di Aspergillus, *Gazz. Ospedali* 16: 769-772.

Meyer, Jacques. 1927. Contribution à l'étude de l'Aspergillus fumigatus Fresenius. Etude expérimentale de l'influence du radium et des milieux sur la production de phénomènes sexués, *Thèse Fac. Pharm. Univ. Strasbourg* 31: 1-112, *30 figs.*

Miller, H. Lindsay. 1891. Nephrotomy in a case of nephromycosis aspergillina, *Australian Med. Jour.* 13: 275-278.

Mirsky, Bojana. 1908. Sur quelques causes d'erreur dans la determination des Aspergillées parasites de l'homme, *Thèse Doct. Med. Nancy,* 76 pp.

Montemartini, G. 1928. Contributo allo studio delle micosi spleniche, *Boll. Ist. Sieroterapico Milanese* 7: 637-643.

Montoya y Florez, J. B. 1897. Note sur les caratés, *Ann. Derm. Syphiligr.* 8: 464-467.

—. 1898. Recherches sur les caratés de Colombie, *Thèse Fac. Méd. Paris* 25: 146 pp.

—. 1899. Commentarios sobre el historico de los caratés, *Arch. de Parasitol.* 2: 596-605.

Mori, Nello. 1916. Natura ifomicetica dei corpuscoli della pleuropulmonite exsudativa della capre. Il germe specifico e'un aspergillo, *Pathologica* 8: 311-315.

Motta, Roberto. 1926. Contributo allo studio delle micosi del condotte uditivo esterno (Studio clinico e micologico), *Atti R. Accad. Fisiocrit. Siena* IX, 17: 603-631, *9 figs.*

Nakayama, Heijiro. 1903. Pneumonomycosis aspergillina hominis, *Zeitschr. Heilk. Abt. Path. Anat.* 24: 348-358.

Nanta, A. 1927. Une mycose splénique. Étude histologique, *Ann. Anat. Path. Anat. Norm. Méd. Chirurg.* 4: 573-586, *1 pl., 3 figs.*

Nanta, A. & L. Chatellier. 1928. Aspergillose cutanée et splenomycose, *Bull. Soc. Franç. Derm. Syphiligr.* 1928: 621-623.

Nanta, A., E. Pinoy & Gruny. 1926. Sur certains splénomégalies granulomateuses à caractères cliniques du type Banti, de nature infectieuse, *C. R. Soc. Biol.* 94: 635, 636.

Nanta, A. et al. 1928. À propos du mémoire de M. Langeron "Que penser des mycoses de la rate?" [réponses aux objections par Maurice Langeron], *Presse Méd.* 36: 579-581.

Negri, G. 1921. Ricerche sulla biologia di un Penecillo patogeno (Penicillium mycetomagenum Mant. & Negri), *Atti R. Accad. Sci. Torino* 66: 67-78.

Nencioni, Mario. 1924. Onicomicosi da Scopulariopsis brevicaulis (var. hominis sin. Penicillium brevicaule var. hominis), *Giorn. Ital. Mal. Ven. Pelle* 65: 972-977, *2 pls.*

Neto, Vilas B. & César Martins. 1931. Sur un nouvel agent parasitaire Scopulariopsis lingualis isolé dans un cas de mycose de langue, *C. R. Soc. Biol.* 106: 1179-1181.

Neveu-Lemaire, Maurice. 1920. Géographie Medicale. Caratés et pinta, **La Géographie* [reprinted in *Presse Méd.* 28: 1376, 1377, 1920].

Nicaud, P. 1928. Les formes actinomycosiques de l'Aspergillus fumigatus, *C. R. Soc. Biol.* 99: 1565-1567.

Nicolle, Charles & E. Pinoy. 1906. Sur un cas de mycétome aspergillaire observé en Tunisie, *Arch. de Parasitol.* 10: 437-458, *1 pl.*

Niño, Flavio L. 1931. Onicomicosis generalizada de origen penicillar, *Bol. Inst. Clin. Quirúrg. Univ. Buenos Aires* 6: 27-34, *8 figs.* [*6ta Reunión Soc. Argent. Patol. Reg. del Norte, Salta,* 1930.]

Nölting, F. 1870. Über eine Pilzbildung im Ohre, *Zeitschr. Parasitenk.* 2: 64, 65.

Noyes, A. W. Finch. 1905. Aspergillus niger growth on the tongue, *Intercolonial Med. Jour. Australia* 10: 153, 154.

Oberling, C. 1928. Le rôle pathogène de la mycose splénique de Nanta, *Presse Méd.* 36: 2, 3.

Obici, Augusto. 1898. Über die pathogenen Eigenschaften des Aspergillus fumigatus, *Beitr. Path. Anat. Allg. Physiol.* [Ziegler] 23: 197-237.

Osler, W. 1887. Aspergillus from the lung, *Trans. Path. Soc. Philadelphia* 13: 108, 109.

Ota, Masao. 1923. Sur une nouvelle espèce d'Aspergillus pathogène: Aspergillus Jeanselmei n. sp., *Ann. Parasitol. Hum. Comp.* 1: 137-146.

Ota, Masao & Shûji Kawatsure. 1933. Zur Aetiologie der echten und falschen Blastomykosen besonders der Gilchristschen Krankheit, *Arch. Derm. Syphilis* 169: 149-172, *11 figs.*

Ota, Masao & Ginji Komaya. 1924. Über eine neue Art der Gattung Scopulariopsis (Bainier): S. Castellanii, *Derm. Woch.* 78: 163-165, *1 fig.*

*Pacini. 1851. Otomycosis aspergillina, *Gaz. Med. Ital. Toscana* II.

Panayotatou, Angélique. 1927. Sur une mycose isolée de la langue d'un malade. Penicillium linguae (genre Scopulariopsis), *Centralbl. Bakt.* I, 101: 231-235, *6 figs.*

Pasini, A. 1930. Oosporosi cutanea da Oospora D'Agatae, *Giorn. Ital. Derm. Sifilol.* 71: 990-999, *2 pls.*

Peña Chavarría, Antonio & Paul G. Shipley. 1925. Contribución al estudio de los carates de América Tropical, *Rev. Méd. Latino-Americana* 10: 648-721, *18 figs., 3 maps, 4 diagrams.*

Peutz, J. L. A. 1932. Primaire aspergillose der longen, *Nederl. Tijdschr. Geneesk.* 76: 1: 446-451, *1 pl.*

Pinoy, E. 1906. Réproduction expérimentale du mycétome à grains noirs, *C. R. Acad. Sci.* 143: 1175, 1176.

*—. 1927. Diagnostic microbiologique de la mycose splénique, *Congr. Franç. Méd.* 19:

Pinoy, E. & P. Masson. 1915. Mycétome du poumon de l'âne, *Bull. Soc. Path. Exot.* 8: 11, 12.

Pinoy, E. & A. Nanta. 1927. Sur l'existence fréquente d'une mycose de la rate en Algérie, *C. R. Acad. Sci.* 184: 347, 348.

—. 1927. Aspergillose expérimentale chez le lapin, *C. R. Soc. Biol.* 97: 67, 68.

Podack, Max. 1895. Zur Kenntnis der Aspergillmykosen im menschlichen Respirationapparate, *Arch. Path. Anat. Phys.* [Virchow] 139: 260-281.

Pollacci, Gino. 1921. Miceti del corpo umano e degli animali, *Atti Ist. Bot. R. Univ. Pavia* 18: 123-131, *Pls. 30, 31.*

*Popoff, L. V. 1887. Ein Fall von Mycosis Aspergillina bronchopneumonica. Varsovie [in Russian]. [*Baumgarten's Jahresber.* 3: 316, 317, 1887.]

Potain. 1891. Un cas de tuberculose aspergillaire, *L'Union Méd.* III, 51: 449-452.

Puestow, K. L. 1929. Maduromycosis, a contribution to the study of maduromycosis with report of a case of infection with Aspergillus nidulans, *Arch. Derm. Syphilol.* 20: 642-664.

Quevedo, José M. 1912. Sur une encephalo-myelite épizootique d'origine mycosique chez les chevaux, *Premier Congr. Internat. Path. Comp.* 2: 200-202.

Reimann, Hobart A., Timothy J. Kurotchkin & Edith Tso. 1929. Studies on the etiology of splenomegaly of unknown origin (Splenic mycosis ?), *Proc. Soc. Exp. Biol. Med.* 26: 410-413.

Rénon, Louis. 1893. Recherches cliniques et expérimentales sur la pseudotuberculose aspergillaire, *Thèse de Paris,* 98 pp., *2 pls.*

—. 1897. Étude sur l'aspergillose chez les animaux et chez l'homme, Masson et Cie. Paris, xii, 301 pp.

Ribbert, H. 1885. Weitere Untersuchungen über das Schicksal pathogener Pilze im Organismus, *Deutsch. Med. Woch.* 11: 535-537.

—. 1888. Ueber wiederholte Infektion mit pathogenen Schimmelpilzen und Abschwächung derselben, *Deutsch. Med. Woch.* 14: 981, 982.

Risel, W. 1906. Aspergillus niger bei Pneumonomykosis aspergillina, *Deutsch. Arch. Klin. Med.* **85**: 255-285, *Pl. 6, 1 fig.*

Rodriguez Arjona, Vicente. 1927. Beitrag zur Kenntnis des Pinta (mal de pinto) der Halbinsel Yucatan, *Arch. Schiffs-Tropen Hyg.* **31**: 472-477.

Roeckl, G. 1884. Ueber Pneumonomykosen, *Deutsch. Zeitschr. Thiermed.* **10**: 122-132, *Pl. 12.*

Romanov, N. A. 1928. Eine durch Meningitis komplizierte Schimmelpilzerkrankung der Stirnhöhle bei einem Pferde, *Arch. Wiss. Prakt. Tierheilk.* **58**: 634-643, *3 figs.*

Ross, J. B. 1891. Moulds and yeasts as morbific agents, *Australian Med. Jour. N. S.* **13**: 382-402, 445-457.

Rother, S. 1877. Ein Fall von geheilter Pneumonomykosis aspergillina, *Charité Ann.* **4**: 272-277.

*Rothwel, Th. A. 1899. Dissertation on aspergillosis. *The Victoria Univ. Manchester, England,* 66 pp.

—. 1901. Experimental aspergillosis, *Jour. Path. Bact.* **7**: 34-52, *Pl. 1.*

Sabouraud, Raimond. 1898. Les caratés, *Ann. Derm. Syphiligr.* **9**: 673, 674.

Salisbury, J. H. 1875. Vegetations found in the blood of patients suffering with erysipelas, *Zeitschr. Parasitenk.* **4**: 1-5, *Pl. 1.*

Sartory, Antoine. 1916. Mycose à Scopulariopsis Koningi, *Progrès. Méd.* **31**: 107, 108.

—. 1919. Un champignon pathogéne nouveau du genre Scopulariopsis isolé d'un pus de plaie de guerre, *Bull. Acad. Méd.* [Paris] III, **81**: 783, 784.

—. 1919. Onychogryphoses et onychomycoses, *Bull. Acad. Méd.* [Paris] III, **82**: 162, 163.

—. 1919. Étude d'un Aspergillus du groupe fumigatus, Aspergillus fumigatus var. minimus, *Bull. Acad. Méd.* [Paris] III, **82**: 304, 305.

—. 1919. Sur un nouveau champignon du genre Scopulariopsis isolé d'un cas d'onychomycose, *C. R. Acad. Sci.* **169**: 703, 704.

—. 1920. Sur un champignon nouveau du genre Aspergillus, isolé dans un cas d'onychomycose, *C. R. Acad. Sci.* **170**: 523, 524.

Sartory, Antoine & P. Bailly. 1921. Du pouvoir agglutinant du sulfate de thorium sur les spores d'Aspergillus fumigatus Fr., *C. R. Acad. Sci.* **172**: 1257, 1258.

Sartory, Antoine & L. Flament. 1920. Étude morphologique et biologique d'un Aspergillus nouveau isolé d'expectorations d'un malade suspect de tuberculose pulmonaire, *C. R. Soc. Biol.* **93**: 1114, 1115.

Sartory, Antoine, G. Hufschmitt & Jacques Meyer. 1930. Contribution à l'étude des onychomycoses. Un nouveau champignon du genre Scopulariopsis Bainier (Scopulariopsis minimus), *Bull. Acad. Méd.* [Paris] III, **103**: 604-606.

Sartory, Antoine & A. Jourdre. 1908. Caractères biologiques et pouvoir pathogène du Sterigmatocystis lutea Bainier, *C. R. Acad. Sci.* **146**: 548, 549.

—. 1908. Caractères morphologiques, biologiques et pouvoir pathogène du Sterigmatocystis fusca Bainier, *C. R. Soc. Biol.* **64**: 926-928.

Sartory, Antoine & R. Sartory. 1925. Étude d'un Scopulariopsis isolé dans un cas d'onychomycose, *Bull. Acad. Méd.* [Paris] III, **93**: 707-709.

Sartory, Antoine, R. Sartory, G. Hufschmitt & Jacques Meyer. 1930. Un cas d'onychomycose provoquée par un Eurotium nouveau: Eurotium diplocyste n. sp., *C. R. Soc. Biol.* **104**: 881-883.

Sartory, Antoine, R. Sartory & Jacques Meyer. 1926. Étude de l'action du radium sur l'Aspergillus fumicatus Fresenius en culture sur milieux dissociés et non dissociés, *C. R. Acad. Sci.* **183**: 77-79.

—. 1926. La formation des perithèces chez l'Aspergillus fumigatus Fresenius sous l'influence du radium, *C. R. Acad. Sci.* **183**: 1360-1362.

Savouré, Pierre. 1905. Recherches expérimentales sur les mycoses internes et leurs parasites, *Arch. de Parasitol.* **10**: 5-70.

Saxer, Fr. 1900. Pneumomycosis aspergillina. Anatomische und experimentelle Untersuchungen. G. Fischer, Jena, 169 pp., *4 pls.*

Schmidt, Albert. 1897. Über die Bedingungen der Conidien-Gemmen und Schlauchfrucht-production bei Sterigmatocystis nidulans, *Inaug. Diss. Greifswald,* 40 pp., *2 pls.*

Schönherr, August. 1932. Ueber die Schimmelpilzerkrankung der menschlichen Lunge, *Inaug. Diss. Med. Fak. Univ. Heidelberg,* 39 pp.

Schubert, Paul. 1884. Zur Casuistik der Aspergillusmykosen, *Deutsch. Arch. Klin. Med.* **36:** 162-179.

—. 1889. Fadenpilze in der Nase, *Berlin. Klin. Woch.* **26:** 856, 857.

Schütz. 1884. Über das Eindringen von Pilzsporen in der Athmungswege und die dadurch bedingten Erkrankungen der Lungen und über den Pilz des Hühnergrindes, *Mittheil. K. Gesundheitsamte* **2:** 208-227.

Schwartz, Georg. 1904. Ein operatio behandelter Fall von Pneumomykosis aspergillina, *Zeitschr. Klin. Med.* **56:** 120-127.

Schweizer, A. 1927. Über aegyptische Splenomegalie, *Schweiz. Med. Woch.* **57:** 1017-1027, *7 figs.*

Scott, H. H. 1928. Reports on deaths occurring in the society's gardens during the year 1927, *Proc. Zool. Soc. London* **1928:** 81-119.

Ségal, J. 1923. Notes on a fungus isolated from guinea pigs inoculated with the virus of typhus fever, *Jour. Path. Bact.* **26:** 156-163, *Pl. 23.*

Shear, Cornelius Lott. 1922. Life history of an undescribed Ascomycete isolated from a granular mycetoma of man, *Mycologia* **14:** 239-243.

Siebenmann, F. 1883. Die Fadenpilze Aspergillus flavus, niger, fumigatus; Eurotium repens (und Aspergillus glaucus) und ihre Beziehung zur Otomycosis Aspergillina, *Zeitschr. Ohrenheilk.* **12:** 124-161.

—. 1889. Ein zweiter Fall von Schimmelmykose des Rachendaches, *Monatsber. Ohrenheilk.* **23:** 73-76.

—. 1889. Die Schimmelmykosen des menschlichen Ohres. Wiesbaden ed. 2, 118 pp., *4 pls.*

Silva, Flaviano. 1926. Considerações en torno de um caso de ''purú purú,'' *Brasil Med.* **40:** 2: 113-119, *3 figs.*

Simon. 1922. Aspergillose saprophyte des bronches. Anévrysme aortique, *Rev. Méd. de l'Est.* **50:** 339-342.

Sion, V. & N. Alexandrescu. 1908. Sur la toxicité d'un type d'Aspergillus fumigatus isolé du mais avarié. *C. R. Soc. Biol.* **64:** 288, 289.

Solmersitz, F. 1906. Beitrag zur Aspergillus Mykosis der menschlichen Lunge, *Deutsch. Med. Woch.* **32:** 1490-1492.

Spegazzini, Carlos. 1925. Un nuevo Aspergillus patogeno, *Physis Rev. Soc. Argentina Cient. Nat.* **8:** 115-117.

Steele, Albert E. 1926. A case of infection with Aspergillus versicolor, *Boston Med. Surg. Jour.* **195:** 536-538.

Steudener, F. 1870. Zwei neue Ohrpilze nebst Bemerkungen über die Myringomycosis, *Arch. Ohrenheilk.* **5:** 163-168, *Pl. 1.*

Stokes, W. R. & S. McCleary. 1928. A case of pulmonary mycosis, *Boston Med. Surg. Jour.* **197:** 1350-1353, *3 figs.*

Talice, Rodolfo V. & Juan E. Mackinnon. 1929. Penicillium Bertai n. sp. agent d'une mycose broncho-pulmonaire de l'homme, *Ann. Parasitol. Hum. Comp.* **7:** 97-106.

—. 1931. Aspergillus (Eurotion) montevidensis n. sp. aislado de una otomicosis de hombre. *Sociedad de Biol. de Montevideo,* 61 sesión, 4 pp.

—. 1932. Tres casos de otomicosis por Aspergillus observados en Montevideo, *Reunión Soc. Argent. Patol. Reg. del Norte, Tucumán* **7:** 278-284.

Tourmanoff, K. 1928. Au sujet de l'aspergillomycose des abeilles, *C. R. Acad. Sci.* **187:** 391-393.

Ureta, Eduardo. 1924. Pinta or carate with special reference to treatment, *Internat. Conf. Health Prob. Trop. Amer. United Fruit Co.* 524-532.

Vignolo-Lutati, Carlo. 1913. Ueber eine neue Mykosis (Acauliosis), [tr. J. Ullmann], *Arch. Derm. Syphilis* **118:** 681-698, *Pl. 21.*

Vuillemin, Paul. 1904. L'Aspergillus fumigatus est-il connu à l'état ascosporé? *Arch. de Parasitol.* 8: 540-542.

—. 1911. Différence fondamentale entre le genre Monilia et les genres Scopulariopsis, Acrosporium, et Catenularia, *Bull. Soc. Myc. France* 27: 137-152.

—. 1920. Fructifications de champignons découverte dans l'ongle par Louis Jannin, *C. R. Acad. Sci.* 170: 788-790.

—. 1927. Sartorya, nouveau genre de Plectascinées angiocarpes, *C. R. Acad. Sci.* 184: 136, 137.

Wätjen, J. 1928. Zur Kenntnis der Gewebsreaktionen bei Schimmelmykosen, *Arch. Path. Anat. Physiol.* [Virchow] 268: 665-685, *3 figs.*

Wehmer, Carl. 1901. Die Pilzgattung Aspergillus, *Mém. Soc. Phys. d'Hist. Nat Genève* 33: 2d. part, No. 4, 160 pp., *5 pls.*

—. 1903. Das Aspergillus des Tokélau, *Centralbl. Bakt.* I, 35: 140-146, *8 figs.*

—. 1913. Uebergang älterer Vegetationen von Aspergillus fumigatus in Riesenzellen unter Wirkung angehäufter Säure, *Ber. Deutsch. Bot. Ges.* 31: 257-268, *7 figs.*

Weichselbaum, A. 1878. Eine Beobachtung von Pneumonomykosis aspergillina, *Wien. Med. Woch.* 28: 1289-1292.

Weidman, Fred. D. 1915. A Penicillium (species?) superimposed on a tuberculous peritonitis and pleurisy, *Proc. Path. Soc. Philadelphia* 17: 62.

—. 1920. Penicillium brevicaule var. hominis (Saccardo 1877) Brumpt & Laugeron 1910 in an American case of ringworm of the toes, *Arch. Derm. Syphilol.* 2: 703-715.

Weill, P. Émile, Paul Chevalier & P. Flandrin. 1928. Contribution à l'étude des pseudosarcomes spléniques, *Le Sang* 1: 361-373, *5 figs.*

Weill, P. Émile, Paul Chevalier, Raymond Gregoire, & P. Flandrin. 1928. La splénomegalie primitive aspergillaire, *Le Sang* 1: 509-609, *1 pl., 6 figs.*

Weill, P. Émile & L. Gaudin. 1919. Recherches sur les onychomycoses, *C. R. Soc. Biol.* 82: 121, 122.

—. 1919. Contribution à l'étude des onychomycoses à Penicillium, à Scopulariopsis, à Sterigmatocystis, à Spicaria, *Arch. Méd. Exp.* 28: 452-467, *Pl. 12.*

Weill, P. Émile, Raymond Gregoire & P. Flandrin. 1927. Splénomegalie mycosique, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 51: 713-717.

—. 1927. Anatomie pathologique de la splénomegalie mycosique, *Ann. Anat. Path. Anat. Norm. Méd. Chirurg.* 4: 587-593, *1 pl.*

Weiss, Pedro. 1930. Sur un Sterigmatocystis agent d'une dermatose semblable au Pityriasis versicolor flava. S. cinnamominus n. sp., *Ann. Parasitol. Hum. Comp.* 8: 189-193, *5 figs.*

Wheaton, S. W. 1890. Case primarily of tubercle in which a fungus (Aspergillus) grew in the bronchi and lung, simulating actinomycosis, *Trans. Path. Soc. London* 41: 34-37, *Pl. 2, Fig. 1.*

Winfield, James McF. 1897. A favus-like eruption of the oral mucous membrane caused by Aspergillus nigrescens, *Jour. Cut. Genito-Urin. Dis.* 15: 13-17, *3 figs.*

Wreden, Robert. 1867. Recherches sur deux espèces de végétaux parasites (Aspergillus flavescens et Aspergillus nigricans) de l'homme, *C. R. Acad. Sci.* 65: 368-371.

—. 1874. Die Myringomycosis Aspergillina in den Jahren 1869-1873 nach eigenen und fremden Beobachtungen besprochen, *Arch. Augen-Ohrenheilk.* 3: 56-90, *Pl. C., Figs. 1-4.*

Xalabarder, X. 1927. Micosis pulmonar producida por una especie de Penicillium, *Rev. Méd. Barcelona* 8: 574-577.

Zarnirko, C. 1891. Aspergillusmykose der Kieferhöhle, *Deutsch. Med. Woch.* 17: 1222.

Ziegenhorn, Otto. 1886. Versuche über Abschwachung pathogenen Schimmelpilze, *Arch. Exp. Path. Pharm.* 21: 249-268.

Zürn, A. 1876. Beiträge zur Lehre von den durch Pilze hervorgerufenen Krankheiten der Hausthiere, *Arch. Wiss. Prakt. Thierheilk.* 2: 110-114, *Pl. 2.*

CHAPTER XVIII

FUNGI IMPERFECTI

The many fungi whose life cycle is little known are usually grouped as Fungi Imperfecti. From its origin, it is obviously a large artificial group of more or less unrelated species. In this work I have removed from the Fungi Imperfecti all those genera where there seemed reason to believe that they were closely related to other genera whose whole life cycle is known; e.g., the group usually called *Monilia* by medical men has been removed to the Eremascaceae Imperfectae, although it is quite possible that when the life cycles of these species are better known, some may be found to belong elsewhere. I have placed the dermatophytes in an appendix to the Gymnoascaceae, although only one species has yet been found to produce asci. Similarly the species of *Aspergillus* and *Scopulariopsis,* in which no perithecia have yet been demonstrated, have been placed in the Aspergillaceae. Even after all these groups have been removed, there remain several important genera whose relationships with the Ascomycetes are still obscure. It is possible that many of these species represent degenerated lines in which asci never will be produced, but in the last 50 years so many species have yielded to improved cultural technic and media that it seems probable that eventually many more may be placed. Hence, the Fungi Imperfecti are conceived as a temporary dumping ground until the gaps in our knowledge have been filled.

The older authors attempted to divide the group on the basis of color and then septation of spores. They divided the Fungi Imperfecti into several groups on the basis of the elaborateness of the fructification in which the conidia were borne. Of these, only those groups in which the spores are borne in coremia or on more or less differentiated conidiophores without protection from sterile tissues need be considered here. For our purposes, even the presence of coremia has little importance. The Hyphomycetes, in which we are interested, were next divided upon the basis of color of spores into the Mucedineae with light colored or hyaline spores and the Dematieae with black spores. While this differentiation is often useful, it is very artificial and difficult to apply in certain well-defined groups. Further division was based on the conidiophore and septation of the spore. This system culminated in the complete and elaborate works of Saccardo, and of Lindau and his German coworkers. Even with this system, the Mucedineae with unicellular spores and undifferentiated conidiophores were not well studied, yet it is in these groups that the genera of most interest to the medical man are to be found.

In France, largely due to the work and influence of Vuillemin, the differences between blastospore, arthrospore, and conidium in the narrower sense have been emphasized. To him we also owe the concept of phialide as a highly specialized conidiophore. The various spores of Vuillemin undoubtedly represent different structures, although his distinctions are somewhat difficult to apply. Groups built up on such characters have much more unity than those based on the lumping of the older Saccardian system. Unfortunately Vuillemin was not primarily a systematist, and there has been no systematist among his followers, so that he failed to give us a carefully worked out classification. In his last publications he was very reactionary and tried to undo the good work he proposed earlier.

In this book I have already considered the genera with blastospores, arthrospores, and light colored mycelium in connection with various families of the Endomycetales and Plectascales (Gymnoascaceae); all of the conidial genera with spores borne in chains from phialides in the Plectascales (Aspergillaceae). This leaves the genera with blastospores and arthrospores having black mycelium (the Toruleae) and those not bearing conidia in chains from phialides to be treated here. In the following key I have attempted to include all groups in which no ascospores (perfect stage) are known, with page references to where each group is discussed further. It is felt that, in general, each of these groups is relatively uniform. The tabulation is somewhat arbitrary, but an attempt has been made to arrange the remaining groups in the order of increasing complexity of conidiophore, following tradition in placing groups with multicellular spores at the end of the series.

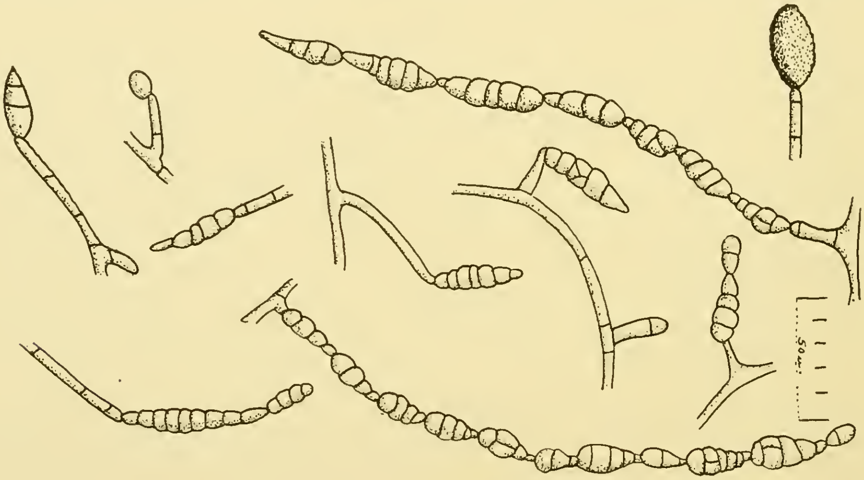

Fig. 105.—*Alternaria* sp. (After Hopkins, Benham & Kesten 1930.)

Key to Larger Groups of Fungi Imperfecti—Hyphomycetes

No differentiation of sporophores, multiplication by sprouting or arthrospores (oidia).
  Cells mostly isodiametric or nearly so, occasionally adhering in chains, but never forming a true filamentous mycelium. *Saccharomycetaceae Imperfectae* (p. 325).
  Cells mostly much longer in one diameter, forming a definite mycelium on most media.
    Colonies not brown or black, producing arthrospores, often multiplying by sprouting. *Eremascaceae Imperfectae* (p. 186).

- Colonies brown or black, arthrospores and chlamydospores present, sprouting not reported or rare. *Toruleae* (sensu Persoon et Saccardo) (p. 669).

- Sporiferous hyphae usually highly differentiated, at least other spore forms besides arthrospores and chlamydospores present.
  - Mycelium very slender, mostly less than 1μ, spores in chains, often borne in elaborate helices,* etc., colony usually chalky, powdery and very slow growing. *Actinomycetales* (p. 694).
  - Mycelium much coarser, spore chains, if present, not forming helices.
    - Spores unicellular.
      - Spores either sessile or on short sterigmata borne on undifferentiated vegetative hyphae.
        - Deep cutaneous lesions. *Sporotricheae* (p. 786).
        - Confined to the horny layer of the epidermis, hair and nails. *Trichophytoneae (Gymnoascaceae Imperfectae)* (p. 433).
      - Spores borne on well-differentiated fertile hyphae.
        - Spores produced endogenously at the tips of phialides.
          - Spores typically in unbranched chains, not embedded in a gel.
            - Phialides hyaline. *Aspergillaceae* (p. 608).
            - Phialides dark colored, conidia usually long cylindric, not spherical or isodiametric. *Chalareae* (p. 822).
          - Spores embedded in a gel at the tip of the phialide; chain structure rarely evident if present.
            - Mycelium light colored. *Cephalosporieae* (p. 823).
            - Mycelium black, mouth of phialide dilated. *Phialophoreae* (p. 833).
          - Spores borne in groups on intercalary swollen cells along the vegetative hyphae. *Gonatobotrytideae* (p. 834).
          - Spores borne singly, rarely in pairs, on variously branched conidiophores, never from phialides.
            - Spores hyaline or light colored.
              - Mycelium usually light colored, very rarely fuscous.
                - Spores borne singly on tips of short branches. *Botrytideae* (p. 835).
                - Spores borne in whorls. *Verticillieae* (p. 841).
              - Mycelium dark colored, brown to black.
                - Spores in heads. *Stachylideae.*
                - Spores borne singly. *Chlorideae.*
            - Spores colored, dark brown to black, mycelium often dark colored.
              - Spores in chains, with youngest spore at the tip of the chain, not at its base as in the Aspergillaceae and Chalareae. *Haplographieae* (p. 843).
              - Spores in whorls. *Arthrineae.*
              - Spores in heads. *Periconieae* (p. 850).

---

*Spore chains are extremely fragile so that a careless mount gives the appearance of a bacterial smear. For methods of making satisfactory mounts, see p. 702.

Spores borne singly on tips of conidiophores.
 Conidiophores unbranched.
 Monotosporieae.
 Conidiophores branched.
 Trichosporieae.

Spores two-celled.
 Spores hyaline. *Hyalodidymeae* (p. 851).
 Spores colored. *Phaeodidymeae.*
Spores multicellular.
 Confined to the horny layer of the epidermis, hair, rarely on nails.
 Trichophytoneae (Gymnoascaceae Imperfectae) (p. 433).

Not isolated from such situations; several groups not known to be pathogenic although some, as *Alternaria* (Fig. 105), *Stemphylium*, *Fusarium*, etc., may be serious laboratory contaminants; in the case of the latter there are two or three cases where the fungus had multiplied on the host and caused irritation at least. Several species from these groups are suspected of producing allergy. (For review of this literature see Brown, 1932.)

CHAPTER XIX

TORULEAE

Toruleae Saccardo, Syll. Fung. **4**: 235, 247, 1886.

The type genus is *Torula* Persoon non Turpin, Pasteur, Hansen, etc.

Mycelium usually dark colored, often black; spores usually dark colored; no differentiation of sporophores; multiplication by arthrospores and chlamydospores, rarely sprouting.

In this group I have combined the Coniosporieae and Toruleae of Saccardo. The Coniosporieae are a small group of species with more or less evanescent mycelium bearing single, terminal black spores of variable shape. The morphology is little known, but I assume that the spores are really arthrospores, or chlamydospores liberated by the disintegration of the hyphae which bear them, not by any specialized mechanism, as in the case of conidia. The Toruleae of Saccardo in a narrow sense include all the dark colored fungi with blastospores or arthrospores, hence the spores are usually in chains. To this group I have also added *Madurella,* a genus whose morphology is not well known. The cells are usually dark colored, in many ways suggesting a *Hormiscium* but apparently not normally producing arthrospores. In cultures, in my experience, it continues to produce sterile hyphae, forming hard, sclerotioid masses very adherent to media and hence very difficult to transfer, while *Hormiscium* produces moister and softer colonies.

There are comparatively few pathogenic species in this group, which is predominantly saprophytic on decaying wood and other vegetable matter. It is quite possible that some species reported as pathogens were contaminants In the case of *Cladosporium,* it has been found frequently enough to justify its inclusion as having pathogenic species. Some would make it the type of another tribe, the Cladosporieae, since it regularly has 2-spored cells. So many confusing transitional states have been reported that it seems better for present purposes to leave it in the Toruleae.

In *Madurella,* there are many species mostly isolated from black grained mycetomata, and in *Indiella,* those from light grained ones. In general, light grains are produced by species of *Actinomyces,* but occasionally *Indiella* is found instead.

The problem of generic names is complicated somewhat as in the imperfect yeasts, especially by the use of the name *Torula* by Turpin, Pasteur, Hansen, and even Guilliermond for asporogenous yeasts. Historically this usage is altogether incorrect. A discussion of the early application of the older generic names in this group follows.

DEMATIUM

Dematium Persoon, Neues Mag. f. Bot. 1: 121, 1794.

Persoon first described this genus in 1794 reprinted with additional notes as *Dispositio Meth. Fung.* 41, 1797, as follows: "Filis subfasciculatis erectis pulverulentis." He divides it into two sections: *Rigida subfasciculata* which includes *D. aureum* and *D. articulatum* on *Allium,* and *Molliora cespitem latum efformantia* which includes *D. abietinum* on *Pinus* and *Abies* (*Picea excelsior*) and *D. virescens* on decaying twigs. Hoffman, in *Deutschl. Flora,* Pl. 13, 1795, used the same genus name without reference to Persoon for *D. verticillatum* and *D. antennaeforme,* the former belonging in the genus *Arthrinium,* the latter transferred later by Persoon to *Torula* and since treated there. In his *Dispositio Meth. Fung.* in 1797 Persoon, in supplementary material on p. 75, gives a more complete description of *D. aureum* with two varieties and adds *D. Hippocastani* and *D. herbarum.*

It would seem best to consider *D. articulatum* the type of the genus since it is the only one figured, although the figure is not very helpful. Since it is reported on *Allium,* it is quite likely that *Xenodochus Allii* Harz (*Torula Allii* Sacc.) should be referred here. It is also likely that *D. abietinum* on *Picea excelsa* (*Pinus Abies* L.) is the same as *Torula grumulosa* Lindau. In this case perhaps Groups 2 and 4 of Lindau's *Torula* belong in *Dematium.*

In Persoon's *Syn. Meth. Fung.* p. 694, 1801, *Dematium* is characterized as "*Byssus forma indeterminata, erecta aut depressa, subfasciculata aut effusa. Fila laevia nec contexta.*" Again he divides into two groups "*Rigida simplex aut fasciculata*" with *D. articulatum, D. verticillatum* Hoffm., *D. ciliare* (*Hypoxylon ciliare* Bull.), *D. epiphyllum, D. strigosum* (*Byssus fulva* Humb.), *D. stuposum, D. bombycinum* (*Byssus Bombycinus* Roth); and "*Cespitosa subintertexta nec pannum s. pellem referentia*" which included *D. petraeum* (*Byssus petraeus* Dillw.), *D. ollare, D. violaceum, D. cinnabarinum, D. impressum, D. virescens* Pers., *D. Hippocastani., D. herbarum, D. brassicae, D. fungorum, D. abietinum* and *D. salicinum.* It is obvious by this time that the idea of a dark color had disappeared, since *D. abietinum* is reported yellow cinnamon, *D. impressum* white, *D. cinnabarinum* red, *D. petraeum* golden, *D. bombycinum* white, *D. stuposum* tawny ferruginous, *D. strigosum* tawny gray, leaving the rest varying shades of olivaceous to black.

In his *Mycologia Eur.* 1822, Persoon again changes his concept very much. Several of his species of 1801 are grouped as *Dematium vulgare* which also includes *Cladosporium herbarum,* etc. *D. atrum* and *D. abietinum* are recognized; *D. asserculorum* and *D. griseum* are transferred here from *Chloridium; D. grumosum, D. epiphyllum,* and *D. graminum* are new; *D. articulatum* and *D. verticillatum* are removed to the doubtful species.

Link, in his revision of the fungi in Willdenow's edition of Linné's *Species Plantarum* 6: 131, 1824, uses *Dematium* in place of *Racodium* of Persoon. Several of Persoon's species of *Dematium* are included in *Cladosporium, D. articulatum* is referred to *Coelosporium fruticulosum, D. verticillatum* to *Spondylocladium fumosum, D. abietinum* and *D. strigosum* are said to be algae, and *D. virescens* is referred to *Sporotrichum.*

Bonorden refers *Dematium* to *Acladium* in his *Handbuch der Mykologie,* 1851. Saccardo, in his *Sylloge Fung.* 4: 308, 1886, uses *Dematium* in the sense of *Sporodum* Corda and does not include any of the species of older authors, which are referred to *Cladosporium herbarum* for most part. Lindau follows Saccardo.

TORULA

Torula Pers., Obs. Myc. 1: 24, 1796.

Persoon first characterized the genus as follows: "*Filis simplicibus articulatis indeterminate effusis, mucidis.*" He included two species *Torula monilis,* from the rotting stem of an umbelliferous plant, characterized "*late incrustans, atra, filorum articulis globosis subcontiguis,*" and *T. fructigena,* which is the common brown rot of plums, etc. He goes on to state that in this genus the spores are never in heads as in his *Monilia* nor branched in digitiform columns as in his *Aspergillus* (not that of Micheli) but articulate; the articles are deciduous, smooth, and simple in contrast to *Dematium*. In the *Syn. Meth. Fung.* p. 693, 1801, he reduces his genus to a subgenus of *Monilia*, changes the specific epithet *monilis* to *herbarum* to avoid reduplication, and transfers *Dematium antennaeforme* Hoffm., *Deutschl. fl. cryptog. Pl. 13, Fig. 4,* 1795, to this section. In his last treatment in the *Myc. Eur.* 1: 20-22, 1822, he again recognizes the genus and removes his *T. fructigena*, adding *T. tenera* Link, Mag. Ges. Naturf. Freunde Berlin 3: 40, 1815 (Nees *Syst.* 2: 20, 1817); *T. fuliginosa α pinophila* (*Antennaria pinophila* Nees, *Syst.* 2: 72, 1817) and *β ericophila* (*Antennaria ericophila,* Link, Neues Jour. f. Bot. 3: 17, 1809). He also adds *Hormiscium expansam* Kunze, *Myc. Hefte* 13, 1818, and *H. alta* Ehrenberg, keeping them distinct as a separate subgenus. He accepts the principle of Link and Nees' separation of *Monilia* and *Torula,* although not the names for his other two subgenera, placing *attenata* in the former and the other species in the latter. Hence, we may conclude that *Torula monilis* (*T. herbarum*) is the type of Persoon's genus, since the other species first described along with it was later excluded, and that this species was retained in his central, largest section of the genus.

Link, in his *Observationes Mycologicae,* Mag. Ges. Naturf. Freunde 3: 21, 1809, accepts Persoon's 1796 treatment, but considers *T. antennata* Persoon as type of his *Monilia.* In his revision of the fungi for Willdenow's edition of Linné's *Species Plantarum* 6: 128, 129, 1824, he limits it to black species with arthrospores, retaining only *T. monilis* (as *T. herbarum*) and *T. tenera.* He treats *Hormiscium* Kunze as *Monilia,* thereby using *Monilia* in a different sense from that of most other authors before or since.

All the early authors used *Torula* for a species with dark colored moniliform hyphae creeping over bark and dead wood or plant stems, easily breaking up into arthrospores.

In 1838, Turpin introduced the first serious complication by applying the name to an organism found in beer. Pasteur picked up the name for yeastlike organisms of beer which do not cause the usual fermentation of sugars. Hansen extended this concept to include all asporogenous yeasts without regard to color or fermentation. Guilliermond continues the tradition of Hansen and, while admitting the possibility of black yeasts belonging here, gives the impression that these forms would probably be found to belong in *Dematium* when they are better known.

CLADOSPORIUM

Cladosporium Link, Mag. Ges. Naturf. Freunde Berlin 7: 37, 1816.

Link originally characterized the genus: *Thallus e floccis caespitosis erectis simplicibus aut subramosis, apicibus in sporidia secedentibus. A Sporothrico et Oidio differt floccis non intricatis, ab Acladio sporidiis apici primum innatis, dein delabentibus.* He described four species: *C. herbarum* (*Dematium herbarum* Pers.), *C. abietinum* (*Dematium abietinum* Pers.), *C. aureum,* and *C. atrum* as new.

In Link's revision of the fungi, in Willdenow's edition of Linné's *Species Plantarum* 6: 39-42, 1824, he treats most of Persoon's species of *Dematium* including here *C. atrum* but not *C. aureum.* Therefore, we may eliminate *C. aureum* from consideration as the type of the genus. The choice thus narrows to the possibility of *C. herbarum* and *C. atrum.* Logically one would choose *C. atrum,* but apparently *C. herbarum* has been most in the minds of later workers. *C. atrum* has unicellular spores while in *C. herbarum* these are 2-celled.

Saccardo, in Michelia 2: 21, 1880, and Syll. Fung. 4: 235, 1882, kept the Persoon—Link tradition and has been followed by mycologists since. Lindau, in Rabenhorst, *Kryptog. Fl. Deutschl.* ed. 2, 8: 567, 1906, characterizes the genus as follows:

Sterile hyphae absent or only a few, branched, septate, hyaline or dark colored. Conidiophores either wholly lacking or only short side branches. Conidia either developing by the complete breaking up of the whole filament or in long chains on the tips of the short side branches which break up into single cells, which are black, brown, olive green, spherical or ellipsoid, or even fusiform.

He divides the genus thus defined into four sections: (1) the whole mycelium breaking up into arthrospores; (2) new spores being cut off continuously from the tips of hyphae eventually giving a basipetal chain; (3) the mycelium growing mostly by sprouting; (4) the mycelium comparatively light colored, with chains of spores developed on partially differentiated, short lateral conidiophores.

Of the above sections, *Torula* should be retained for the first, 2 and 4 should be transferred to *Dermatium,* and 3 to *Pullularia* or perhaps to *Hormiscium.*

HORMISCIUM

This genus was characterized by Hoffman, *Myk. Hefte* **1**: 12, 1817, as follows: ***Fibrae aggregatae vel solitariae, simplices, strictae, rigidiusculae, suppellucidae, articulatae; articulis globosis continuis.*** His Fig. 7 on *Pl. 1* shows single chains of spores rising from the substratum, with no traces of a conidiophore. He recognized only one species, *H. expansum.* Ehrenberg, *Sylvae Myc.* p. 22, 1818, added *H. alta,* from bark of *Alnus glutinosus.* Both these species were treated as a subgenus of *Torula* by Persoon, *Myc. Eur.* p. 22, 1822. Link, in his revision of the fungi for Willdenow's edition of Linné's *Species Plantarum,* places them in his *Monilia* which is apparently strictly a synonym of *Hormiscium.* He adds *Dematium antennaeforme* Hoffman, under name *Monilia* (*Torula*) *antennata* Pers., *M. sparsa* which may be the same as *Dematium articulatum* Pers., and *M.* (*Torula*) *Hammonis* Ehrenberg in litt.

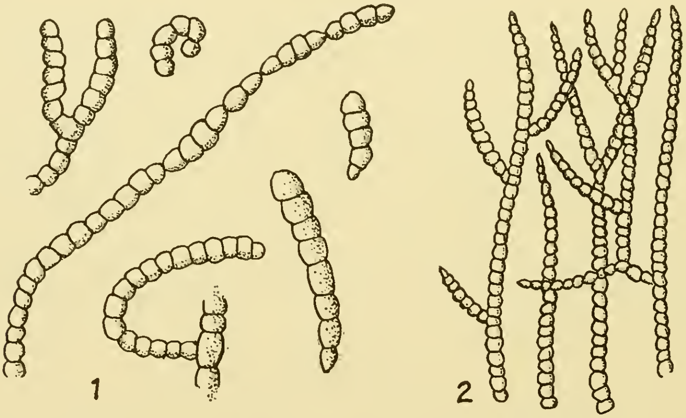

Fig. 106.—*1, Hormiscium stilbosporum* Corda; *2, Hormiscium pinophilum* Nees. (After Corda.)

Saccardo, *Syll. Fung.*, and Lindau, in Rabenhorst, *Kryptog. Fl. Deutschl.* I, **9**: 596-604, recognize the characters as expressed by Link for his *Monilia* (Fig. 106). Lindau recognized the need for a revision of the species referred to *Hormiscium* and *Torula* but did not carry it out.

Key to Genera

Mycelium early evanescent, leaving single black spores varying from spherical to ellipsoid or lenticular, never fusiform. *Coniosporium.*

Mycelium persistent, frequently dark colored (white in *Indiella*).
- Whole mycelium breaking up into arthrospores.
  - Arthrospores short cylindric, chains not readily breaking up. *Hormiscium.*
  - Arthrospores ellipsoid, chains readily breaking up. *Torula.*
  - Arthrospores spherical to short ellipsoid, sprouting. *Pullularia.*

Whole mycelium not breaking up into arthrospores; chains of arthrospores borne on short lateral branches.
Arthrospores ellipsoid to spherical.
Spores rough. *Hemispora* (see p. 182).
Spores smooth. *Dematium.*
Arthrospores 2-celled. *Cladosporium.*
Arthrospores not produced, mycelium tending to form sclerotia, chlamydospores abundant, strictly pathogenic, producing mycetomata.
Mycelium dark gray to black. *Madurella.*
Mycelium remaining white. *Indiella.*

CONIOSPORIUM

Coniosporium Link, Mag. Ges. Naturf. Freunde Berlin **3**: 8, 1809.

The type species is *Coniosporium olivaceum* Link on *Pinus maritima.*

Mycelium scanty, conidiophores hyaline, short, quickly evanescent; conidia spherical to ovoid or lenticular, dark.

Coniosporium onychophilum* Agostini, Boll. Sez. Ital. Soc. Internat. Microbiol. **3**: 214, 215, 1931.

Isolated from lesions of the nails, Italy (case of Tarantelli). Not pathogenic for white mice.

Mycelium dimorphic, some hyphae 2-2.5μ with refractive granules hyaline, little branched and irregularly septate, other hyphae 6-7.5μ with oil droplets, a yellow brown pigment and regularly septate. Arthrospores lenticular, face view circular, 8-12μ in diameter; girdle view fusiform, 8-12 × 4-5μ; occasionally somewhat ellipsoid, 10-12 × 5-7μ. Epispore olivaceous or brown-olivaceous, contents granular, oily, hyaline. On treatment with acid, the wall splits into two halves.

On Pollacci agar, carrot, and potato, colonies floccose, lanuginose, at first white then rose color at the surface and hazel below in the substrate. On Sabouraud agar, colonies less floccose, substrate browning. No growth on blood agar. On Raulin's solution, colonies floating, slightly floccose, rose at first, then hazel, and finally dark brown. In glucose, maltose, and galactose, colonies mucilaginous, becoming cartilaginous and dark brown. On leather, colonies small, floccose, yellow. On feathers, colonies small and whitish. No growth on hair. Ferments glucose, maltose and galactose within 6 days. Optimum temperature between 15° and 25° C.; no germination at 35° C.

PULLULARIA

Pullularia Berkhout, De Schimmelgeschlachten Monilia, Oidium, Oospora en Torula 55, 1923.

Hormonema Lagerberg, Lundberg & Melin, Svenska Skogvårdsfören. Tidskr. **1927**: 219-233, *Figs. 36-42,* 1927.

---

*Spelled *onicophylum* in original publication, spelling corrected in accordance with permission in International Rules of Nomenclature, Art. 70. In her more complete description, Agostini (1932) corrected the spelling.

The type species is *Pullularia pullulans* (Bary in Löw) Berkhout.

Hyphae dark colored, blastospores ovoid and lighter colored, occasionally absent. Hyphae composed of chains of dark, thick-walled large cells. Cultures at first yeastlike, then velvety, dark with lighter margin, sometimes remaining light colored for a long time. Sugars not fermented.

It is extremely doubtful whether this genus is pathogenic, although *P. pullulans* is sometimes so reported.

Pullularia pullulans (Bary in Löw) Berkhout, de Schimmelgeschlachten Monilia, Oidium, Oospora en Torula 54, 55, 1923; Ashford, Porto Rico Jour. Publ. Health & Trop. Med. **5**: 188-195, *1 pl.*, 1929.

Dematium pullulans Bary in Löw, Jahrb. Wiss. Bot. **6**: 467-475, *Pls. 29, 30,* 1868.

Isolated from extensive and deep-seated lesions, on the palms of the hands and the soles of the feet as well as on chest, arms, and legs. Lesions darkly pigmented and heavily crusted with deep infiltration of the skin. Eruption began as small vesicles on the toes, which broke and were covered later by crusts. Obstinate, finally cured by intravenous sodium iodide. No proof of pathogenicity. According to the authors, probably a saprophyte, but detailed to warn other investigators of this ubiquitous organism which may occur in cultures from various sources.

In hanging drop at first sprouting from any part of parent cell. The daughter cell may separate in a few hours or it may grow to normal size while still attached, forming short, sometimes branched chains. Then almost simultaneously all cells in the chain put forth sprouts laterally. These lateral cells usually remain smaller and are sometimes referred to as conidia. They may separate and either continue sprouting or develop true hyaline hyphae, especially on solid media where the central axis of the colony is formed by the chain and its lateral sprouts, intersected by the network of hyphae which the latter produce. These become so intricate that it is no longer easy to make out the structure of the colony. In liquid media, the sprouting cells often become uniseptate (the *Cladosporium* stage). Finally, some of the cells greatly thicken their walls and produce a black pigment. This process continues until the surface of the colony becomes a layer of these hypnospores. If conditions favorable for renewed growth are present, they germinate by fine filamentous hyphae. If conditions continue unfavorable, the walls of the hypnospores gelify and fuse into a blackish or dark yellow crust. They ordinarily do not subsequently germinate but rather serve to protect the sprout cells beneath. Ciferri & Ashford report that the terminal cells of the hyphae are clavate to subspheric and sometimes sprout chains of cells, superficially suggesting *Hormodendron.*

Young colonies white and similar to those of yeasts, older colonies with yellowish tan to brown spots, then black and shining, finally black, opaque (fumagoid type). In liquid cultures, colonies in tufts growing downward from surface, not forming sediment, white becoming grayish and greenish with a maroon surface. No fermentation has been noted in any sugars, although growth is good in media containing glucose, fructose, maltose, dextrin, lactose, 2% methyl or ethyl alcohol, citric, malic, tartaric or acetic acid. Peptone, asparagin, glycocoll, ammonium sulphate or potassium nitrite or nitrate may be utilized as sources of nitrogen.

Cryptococcus metaniger Castellani, Arch. Derm. Syphilol. **16**: 402, 403, 1927; Amer. Jour. Trop. Med. **8**: 393, 1928, probably also belongs here. It was isolated from a case of trichomycosis nigra and described as cells elongate, black, colonies black on all laboratory media. Too vaguely described for definite placing by any one at all familiar with this large group. Ciferri, Arch. Protistenk. **71**: 445, 446, 1930, has also placed it here, while Ferrari (1932) places it in *Cladosporium*.

Pullularia Jeanselmei (Langeron) Dodge, n. comb.

Torula Jeanselmei Langeron, Ann. Parasitol. Hum. Comp. **6**: 385-403, *12 figs.*, 1928.

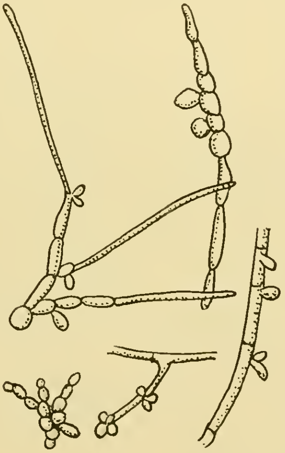

Fig. 107.—*Pullularia Jeanselmei.* (After Langeron 1928.)

Isolated from black grain mycetoma in Paris in a mulatto woman from Martinique. Case history by Jeanselm, Huet & Lotte, 1928.

Mycelium in lesions forms grains 500-1,000μ in diameter, soft, irregular, and appearing like hollow cylinders. Hyphae coiled, interstitial gel not well developed. Hyphae, 2.5-3μ in diameter, forming chains of arthrospores, 4.5-5μ, which soon disintegrate (Fig. 107).

In cultures, the arthrospores form chains of spherical cells which laterally produce ovoid blastospores in the vicinity of the septa. Toward edges of the colony, fewer lateral chlamydospores are produced and terminal whorls like conidia are produced on short lateral branches. These chlamydospores are 2.5 × 5μ, often with 3-8 per group. On sugar media contours are rounded and submoniliform. Cultures grow well at 22°-25° C. on the usual media (Sabouraud glucose and malt agars, potato-glycerol, carrot and potato decoctions).

I have hesitated to place this species in *Pullularia* but it apparently has blastospores as well as chlamydospores. From its source, one would expect it to be related rather with *Madurella*.

DEMATIUM

Dematium Persoon, Neues Mag. Bot. **1**: 121, 1794.

Montoyella Castellani & Chalmers, Man. Trop. Med. ed. 2, 799, 1913.

The type species is *Dematium articulatum* Persoon, isolated from *Allium* (Fig. 108).

Hyphae hyaline, septate, branched, bearing chains of smooth, black arthrospores on lateral branches (Fig. 109).

The species are predominantly parasitic or saprophytic on plants. The pathogenic species referred here have not been very carefully described, and their reference here is somewhat doubtful. On the other hand, there is nothing in their descriptions to warrant placing them in *Cladosporium* which has two-celled arthrospores. It is to be hoped that some one will undertake a careful study of the morphology of the whole group with black arthrospores. These species seem to produce relatively superficial lesions on the skin.

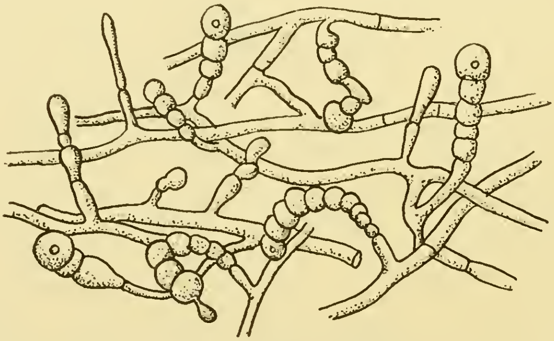

Fig. 108.—*Dematium articulatum* Pers. (*Torula Allii* Sacc.) type of the genus *Dematium*. (After Lindau 1906.)

Dematium Wernecki (Parreiras Horta) Dodge, n. comb.

Caraté noir Montoya y Florez, Recherches sur les caratés de Colombie, Thèse Méd. Paris **25**: 48, 49, 1898.

Montoyella nigra Castellani & Chalmers, Man. Trop. Med. ed. 2, 799, 1913, non *Dematium nigrum* Link 1809.

Cladosporium Wernecki Parreiras Horta, Rev. Med. Cirurg. do Brasil **29**: 269-274, 1921.

Cladosporium sp. Rietmann, Bull. Soc. Derm. Syphiligr. **37**: 202-207, 1930; Sartory, Sartory, Rietmann & Meyer, C. R. Soc. Biol. **104**: 878-881, 1930.

The organism usually isolated from black *Caraté, pinta,* or *Kcara* in South America. Peña Chavarría & Shipley (1925) report a species of *Alternaria* from such lesions [probably a contamination].

We owe our first extensive study of this disease to Montoya y Florez who described it in Colombia as apparently confined to full-blooded negroes. Producing spots from 0.5-2 mm. in diameter on the forehead, chin, forearms, and legs; rarely generalized, smooth, not pruriginous or scaly. The skin is much vascularized and the epidermis very adherent. Sometimes it remains in this stage, at other times it results in achromia which may cover the whole body except the face, backs of the hands, and feet. The plantar surface is usually hyperkeratinized. The disease in Brazil was first described by Parreiras Horta from the case of João Ramos e Silva and José Torres in Werneck Machado's service. The lesion was a black spot on the left hypothenar region, slightly elevated with slight desquamation. Silva (1929) reports a similar lesion on the side of the middle finger. Fonseca & Ferreira da Rosa (1930) report it from various sites on the hand, frequently causing hyperkeratosis of the palmar surface. The white race seems to be affected as well as the negro in Brazil. Cerqueira studied the condition as early as 1891 but did not publish his results. A. Sartory, R. Sartory, Rietmann & J. Meyer found subcutaneous and intraperitoneal injections into guinea pigs negative. Superficial inoculation in the inguinal region produced black plaques developing in 5-7 weeks, forming scaly crusts before spontaneous healing. The liquid from culture media produced death by anaphylactic shock. Lesions were easily reproduced on inoculation into human subjects.

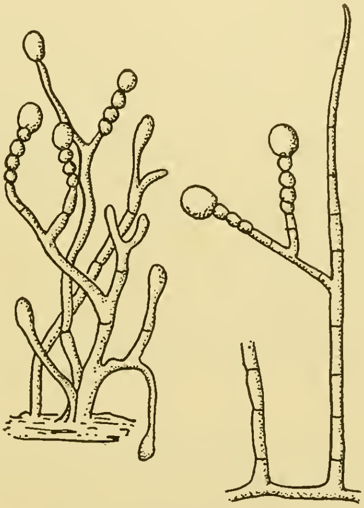

Fig. 109.—*Dematium hispidulum.* (After Saccardo.)

Mycelium dimorphic, some hyphae slender and branched, septate, other hyphae larger, varicose, thick-walled with many chlamydospores; hyphae arising from the massive mycelium bearing terminal pyriform conidia. In scales, hyphae long, septate, terminated by arthrospores; others slender, solitary, rounded or narrowed at the tips, often flexuous, whole mycelium dark greenish, rarely branched; spores variable in size, spherical or ovoid, not in chains. Fonseca & Ferreira Rosa (1930) report hyphae branched in scales.

On glucose agar, the *Fumago* form with rounded cells, thick-walled, sometimes deeply colored. On carrot, the *Dematium* form with mycelium of short cells, with simple blastospores; yeast forms abundant, giving cultures humid or varnished aspect. In carrot decoction, delicate mycelium with abundant spores furnished with thickenings which serve as disjunctors. At first colony easily separable from medium, giving the appearance of a black yeast; later it becomes very hard with elevations and depressions similar to those of *Trichophyton acuminatum*. Colony covered with a greenish bloom which leaves a very black core. A. Sartory, R. Sartory, Rietmann & J. Meyer (1930) report that it grows best on lipoid-containing media. It utilized glycine, hippuric acid, creatine, and creatinine freely, purines slowly and secondarily, urea and guanidine not at all.

Dematium Mansoni (Castellani) Dodge, n. comb.

Microsporum Mansoni Castellani, Brit. Med. Jour. **2**: 1271, 1905.

Foxia Mansoni Castellani, Jour. Trop. Med. Hyg. **11**: 260, 1908.

Cladosporium Mansoni Pinoy, Ann. Derm. Syphiligr. V, **3**: 341-343, 1912.

Torula Mansoni Vuillemin, C. R. Acad. Sci. **189**: 406, 1929.

Isolated from cases of pityriasis nigra in India.

Hyphae short, 18-20 × 2.5μ in diameter, arthrospores spherical, 5-7.5μ, frequently in clusters, uniguttulate.

Pollacci & Nannizzi report that olivaceous hyphae, little branched, 2-2.5μ, are terminated by ovoid or ellipsoid arthrospores, 7-8.5 × 2-2.5μ, one-celled or occasionally two-celled.

On maltose agar, colonies hemispheric, dark greenish to black, coalescing, forming a jet black, rugose mass. On broth and peptone solution, sediment greenish black, no action and little growth on milk. Growth slow on gelatin with little or no liquefaction. Optimum temperature 30°-32° C.; growth slow over 35° or under 25° C.

Dematium Gougeroti (Matruchot) Grigorakis, Bull. Soc. Myc. France **40**: 272-276, *4 figs.*, 1924.

Sporotrichum Gougeroti Matruchot, C. R. Acad. Sci. **150**: 543-545, 1910.

Rhinocladium Gougeroti Verdun, Précis Parasitol. 1913.

Early isolated from a gumma deep in a human leg muscle. Later found in an ulcer on the dorsum of the penis with inguinal adenitis in a young man in Madagascar (Fontoynont & Boucher, 1923) and a very similar case in Porto Rico (Kesten et al., 1932). Grütz (1925) reports it from more superficial lesions. Pathogenic to rats and monkeys (Kesten).

Mycelium of moniliform filaments or isolated sprout cells. These give rise to slender hyphae, which collect and produce black coremia. Spores often borne in lateral tufts. Kesten et al. report spores 3.5-5.5 × 1.5-2.5μ.

Colonies black from the first, elevated, with a velvety surface.

Several have referred *Sporotrichum Lecante* Beurmann & Gougerot to synonymy with this species, but I have been unable to locate the original description of Beurmann & Gougerot.

Dematium Sakuranei (Jannin) Dodge, n. comb.

Oidium sp. Sakurane, Arch. Derm. Syphilis **78**: 211-221, 1906.

Mycoderma Sakuranei Jannin, Les Mycoderma . . . 247, 248, 1913.

Cryptococcus Sakuranei Froilano de Mello & Gonzaga Fernandes, Arq. Hig. Pat. Exot. **6**: 293, 297, 1918.

Monilia Sakuranei Vuillemin, Champ. Parasit. Homme Anim. 86, 1931.

Geotrichum Sakuranei Almeida, Annaes Fac. Med. São Paulo **9**: 12, 1933.

Isolated from cold subcutaneous abscess in a nine-year-old girl in Japan. Neoformation of cell tissue, ulceration of dermis, and painless tumefaction of lymphatic ganglia. Mycelium apparent on direct examination. Pathogenicity not clearly established.

Hyphae and ovoid to spherical cells. True arthrospores seen but no true conidia. Hyphae branched, septate on potato and sugar media.

On ordinary agar, colonies brownish black, circular, more or less irregular, becoming hemispheric, hard, surface spongy, without special elevations, becoming moister in age, easily separable, the colony then consisting principally of arthrospores. On glucose agar, brownish black or dark green, hard, adherent, covered with a thin, gray mycelium which finally becomes brownish black. On potato, colony gray green with gray aerial mycelium at the periphery, growing deep into the medium. On gelatin, colony greenish brown, granular, growth slow, no aerial mycelium, no liquefaction. On glucose broth and milk, spongy flocci below, dark brownish black, hard pellicle on surface. Milk not coagulated.

Doubtful Position

The following species may belong in *Dematium* or in *Torula,* but it is too poorly described for certain determination.

Aspergillus carbonarius seu ater Meis & Parascandalo, Gaz. Ospedali **16**: 769-772, 1895.

Isolated from a case of diphtheria in a dog. Appears to be a contaminant and not pathogenic.

Mycelium not septate, branched. Fertile hypha swollen at apex; spores in chains, "surrounded by a membrane," 5-7μ in diameter, black. Hyphae and mycelium also black.

Optimum temperature for growth 30°-37° C., growth ceasing at 60° C. Growth good on agar, poor on potato, none on egg albumen. On gelatin, small colonies resembling coffee beans. Growth rapid on prune decoction and bread, also on Naegeli's solution. Glucose and sucrose fermented. Gas evolved with gelatin.

This is obviously not a species of *Aspergillus* since it has black mycelium. It is too poorly described to identify, but probably is a saprophytic *Dematium.*

MADURELLA

Madurella Brumpt, C. R. Soc. Biol. **57**: 999, 1905.

Streptothrix mycetomi Laveran is the type species.

Mycelium white at first, parasitic on a variety of animal tissues; bones, muscles, connective tissue. The vegetative hyphae have a diameter always larger than 1μ, sometimes up to 8-10μ. These hyphae are septate, branch from time to time and secrete a brown pigment (Fig. 110). In age they agglomerate into sclerotia where one finds a variable quantity of spherical bodies, 8-30μ in diameter (chlamydospores).

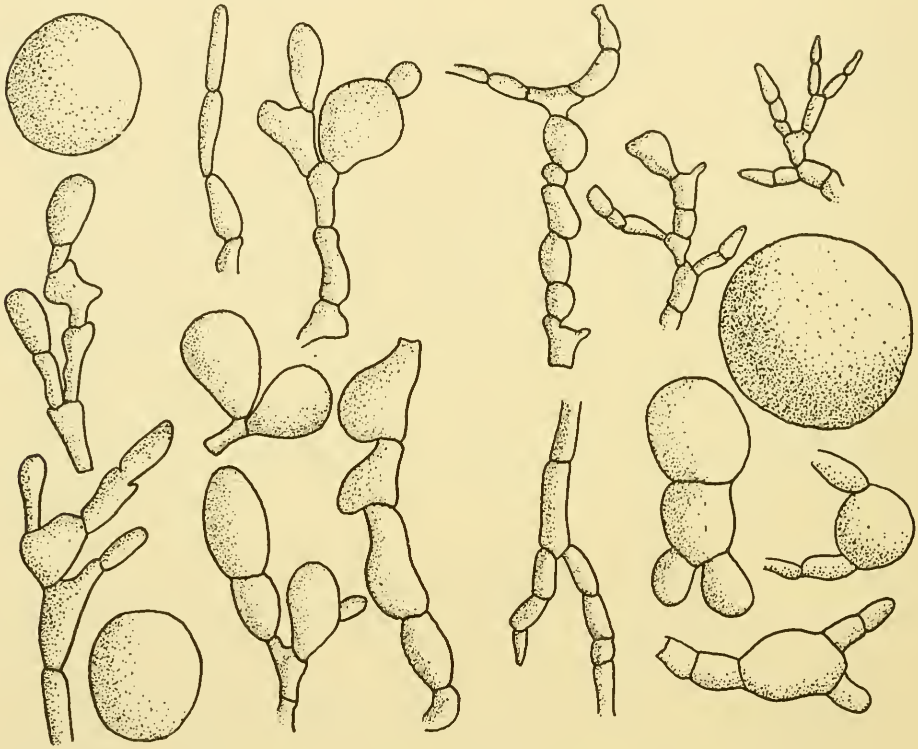

Fig. 110.—*Madurella mycetomi.* Mycelium and chlamydospores. (After Brumpt 1906.)

Members of this genus have been found almost exclusively in mycetoma with black grains (maduromycosis, Madura foot, etc.). This disease has been known clinically for several centuries in India and has been repeatedly described (cf. Carter 1874, Brumpt 1906, Musgrave & Clegg 1907, Gammel 1926, Heitor Froes 1930 for excellent summaries of the literature). It seems to be more common in regions with hot dry seasons where the vegetation abounds in thorns and the natives go barefoot, a large proportion of the patients giving the history of a thorn in the foot some time before the lesion became serious. However, the cases are not confined to such regions. The lesions are usually restricted to the feet, but are occasionally found in other situations, such as in the groin and in one patient behind the ear. The lesion begins by swelling of the affected member, usually accompanied by one or more nodules, pustules, or abscesses which, upon rupture, become fistulas. New lesions make their appearance near the first until a considerable portion of the member may be involved. The tumor mass begins to soften, and the lesions burst and discharge an oily, viscid, seropurulent fluid with small black grains (sclerotia). The overlying skin becomes discolored, usually darker, mottled and scarred, surmounted by discharging sinuses. Pain is usually mild or even lacking, but the resulting deformity often interferes with locomotion. In general, the bones are not affected by *Madurella*, although they frequently are when *Actinomyces* is the etiologic agent. Surgical removal of the tumorous mass or amputation is usually the only satisfactory method of treatment.

In the bibliography at the end of this chapter, I have collected all the references to this disease where the organism was not presumably a species of *Actinomyces*, *Monosporium*, or *Aspergillus*.

Key to Species

Colony white.	*M. Tozeuri.*
Colony grayish ashy on carrot, ochraceous on potato, and brown on Sabouraud agar.	*M. Ramiroi.*
Colony greenish gray to purplish gray, becoming purplish when old; on Sabouraud agar yellowish, then purplish.	*M. Oswaldoi.*
Colony grayish white, zonate, center brown, folded, becoming dry membrane, deep chamois or darker.	*M. algiris.*
Colony copper yellow, margin greenish yellow, finally covered with a brown pubescence on Sabouraud agar; gelatin not liquefied.	*M. Tabarkae.*
Colony grayish white, becoming light brown, gelatin liquefied, sclerotia abundant on Sabouraud conservation agar.	
Colonies accuminate on Grütz and Sabouraud agar.	*M. Ikedae.*
Colonies tomentose and cerebriform on Grütz agar, little or no growth on Sabouraud agar.	*M. americana.*

Madurella Tozeuri (Nicolle & Pinoy) Pinoy, Ann. Derm. Syphiligr. V, **3**: 341-343, 1912.

Oospora Tozeuri Nicolle & Pinoy, Bull. Soc. Path. Exot. **1**: 95-99, *1 fig.*, 1908.

Isolated from a growth on the top of the foot, not involving muscles, joints, or bones. Epidermis and dermis only affected. No pain. Lesions eighteen years in developing.

Hyphae straight or flexuous, 1-4μ in diameter. Cells have thick walls. Chlamydospores 2-6μ in diameter. Hyphae united by a brown pigmented mass, or follow blood vessels, branching at the capillaries. Grains 50-100μ in diameter, with outer layer of filaments yellow brown, 1-2μ in diameter.

Organism cultivated on several media. On glucose or maltose agar, in 24 hours at 37° C., white colonies develop with a blackening of the substrate. Same on potato. Media not blackened in the absence of carbohydrates.

Madurella Ramiroi Pirajá da Silva, Brasil Med. **33**: 81-83, 1919; Mem. Inst. Butantan **1**: 187-207, *Pls. 34-38*, 1918-1919.

Isolated from a black grain Madura foot in Brazil. The author was unable to reproduce lesions in pigeons, rats, or bats.

Mycelium moniliform, cells about 2.7μ in diameter; there are slender mycelium producing chlamydospores (intercalary) and moniliform mycelium. Large spherical cells, 22μ in diameter, seen in the sclerotia are probably large chlamydospores similar to those in the grains from lesions.

On Sabouraud glucose, and maltose agars, growth rather rapid, colonies deep brown, cerebriform with abundant pigment formation. Sclerotia rare. Colonies on yam dark gray in the center, with ashy margins. On sweet potato, growth better than on banana (de terra). The culture media blacken as the colonies age. On carrot, growth is grayish ashy, with irregular verrucose surface. Growth best on potato, colonies ochraceous with medium darkening. In potato decoction, tufts of mycelium with small black granules. In hay infusion, there are formed white tufts which adhere to the walls of the tubes and later there are small grains (sclerotia) similar to those from the lesions.

Madurella Oswaldoi Parreiras Horta, A Pathologia Geral Nos. 1-4, 1919, [quoted by Gammel 1926, Fonseca 1930, Froes 1930].

Organism shows a luxuriant mycelium which changes its color during growth from greenish gray to purplish gray, becoming purplish when old. No sclerotia seen in cultures.

Cultures show a central knob with a deep depression and a zone of deep fissures. Growth rapid on all media. On Sabouraud media, colonies are white to dirty yellow and purple; with sugar media, either liquid or solid, darkening.

Madurella algiris (Blanchard) Dodge, n. comb.

Oospora Tozeuri var. Brault & Masselot, Soc. Chirurg. April, 1911; Arch. de Parasitol. **15**: 218-225, 1912.

Discomyces algiris Blanchard.

Oospora algirus Sartory, Champ. Parasit. Homme Anim. 777, 778, 1923.

Isolated from a tumor on the foot of a young Arab fifteen years old. Tumor just behind the space between first and second toes, size of a large nut, surface thin and ready to burst. On puncture, there was exuded a reddish viscous liquid with black grains varying in size from that of a pinhead to that of a grain of wheat. Cavity lined with a thick, soft, brownish tissue. KI was not tolerated. Patient treated frequently with tincture of iodine until cured. Organism not pathogenic to laboratory animals.

In grains, mycelium septate with large intercalary chlamydospores 7 × 12μ in diameter. Hyphae 3μ in diameter, cells 5.5-8μ long.

Growth good on glucose and glucose glycerol agar. Colonies grayish white with concentric rings of growth, center browning and folding. In age it appears as a dry yellow membrane from deep chamois to tinder, with medium becoming black or caramel in color. On potato, growth is poor, colony dirty white, with medium blackening. On carrot, especially with glycerol, growth is similar to that on potato but more rapid. In hay infusion, there are cottony tufts with slight sediment and no clouding of the medium.

Madurella Tabarkae Blanc & Brun, Bull. Soc. Path. Exot. **12**: 741-748, *1 pl.*, 1919.

Isolated from a black grain mycetoma which was subcutaneous without involving muscles or bones. Grains removed and wounds healed normally.

The sclerotia are composed of fine filaments, 2-4μ in diameter, with chlamydospores either terminal or intercalary, 12μ in diameter. Hyphae slender, cells short. Optimum temperature 22° C., growth slow at 35° C.

Organism grows best on Sabouraud maltose agar. On simple Sabouraud agar, it produces good colonies, with the growth finally becoming rounded and folded. Color begins at the center and spreads outward. After one month, center is copper yellow and periphery greenish yellow, with amber yellow guttation in the center. Culture finally becomes covered with a brown pubescence and medium turns brown. Similar, but faster, on Sabouraud maltose agar. On ordinary agar, hay infusion, or potato agar, in 24 hours, small white colonies appear, while medium darkens progressively. Colonies are never large. Similar on lead agar with growth sparse and white. On neutral red agar, growth good with no change or browning of medium. On potato, potato glycerol, or carrot, small white colonies which become yellow and folded; potato rapidly blackens. On coagulated serum, growth as an ordinary agar except that colony is rose at first, later becoming brown. On gelatin stab, there is abundant growth on the surface, which becomes intensely brown with arborization and sclerotium formation below. In beef peptone broth in 24-48 hours, small globular masses are especially abundant in contact with the tube. Medium progressively browned up to the fifteenth day. In peptone broth, growth is the same. No indol formation. No growth in hay infusion. In potato infusion as in beef broth, except that the flocculent colonies slowly collect at the bottom of the tube. Black sclerotia appear in about 25-30 days. In peptone sugar solutions, neither acid nor gas is formed (no fermentation). Growth as in beef broth. In peptone bile, small spherical colonies appear with browning of the medium. Milk is coagulated on the eighth day with browning of the medium and abundant growth on the surface. Gelatin not liquefied.

Madurella Ikedae Gammel, Arch. Derm. Syphilol. **15**: 241-284, *20 figs.*, 1927.

Isolated in Minneapolis by Ikeda from a black grain maduromycosis. Nonpathogenic to rabbit or guinea pig.

Mycelium grayish white, later light brown, darkening certain sugar media. Hyphae hyaline or subhyaline, rarely granular, varying in diameter from 1.5-5μ. Chlamydospores numerous only in Sabouraud glucose broth. In all liquid media many hyphae break up into chains of citriform or spherical spores. Acuminate light brown colonies on both Sabouraud and Grütz agars. Sclerotia numerous on surface and in depth of Sabouraud preservation medium. Pigment production abundant in glucose, galactose, or maltose, moderate in mannite or levulose, poor in dextrin, poor or absent in inulin, saccharose, or lactose broth. Organism ferments milk and is thermophilic. Gelatin liquefied.

Madurella americana Gammel et al., Arch. Derm. Syphilol. **13**: 66-77, *6 figs.*, 1926; *Ibid.* **15**: 241-284, *20 figs.*, 1927.

Acladium americanum Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from black grain mycetoma in Cleveland, Ohio. Animal inoculations negative.

Mycelium yellowish brown and darkening certain sugar media, grayish white when old. Hyphae subhyaline or brown and granular, varying in diameter from 1-5.2μ according to the type and percentage of sugar in the medium. Chlamydospores numerous, especially on Sabouraud glucose broth; arthrospores with squarely cut off ends rare.

Optimal medium for growth is 1% glucose agar. Growth on Sabouraud agar none or very poor. On Grütz agar, colony tomentose or cerebriform. Sclerotia, 1 mm. in diameter, form on surface of gelatin and Sabouraud conservation agar. Pigment formation is abundant in glucose, maltose, dextrin, and galactose; moderate in fructose; poor in sucrose or lactose; absent in inulin broth. Milk is fermented, organism being thermophilic. Gelatin is liquefied.

Madurella mycetomi (Laveran) Brumpt, C. R. Soc. Biol. **57**: 997-999, 1905.

Streptothrix mycetomi Laveran, Bull. Acad. Méd. Paris III, **47**: 773-776, *Fig. 1,* 1902.

One of the commonest species producing mycetoma with black grains. Laveran does not report spore or cultural characters, although he recognized the characters which separate it from *Actinomyces.* Brumpt, Bouffard, and Chabaneix give interesting case histories and clinical observations but were unsuccessful in their attempts to cultivate it. Chatterjee, Centralbl. Bakt. I, **61**: 358-365, *Pls. 1, 2,* 1911, was the first to describe cultural characters. Noc & Jouenne, Ann. Inst. Pasteur **36**: 365-385, 1922, give cultural characters in detail. Puyaubert & Jolly (1918, 1920) report an interesting case in the perineum extending from the base of the scrotum to within 3 cm. of the anus, involving muscular tissues only. They cultivated the organism which was not pathogenic for guinea pig.

Doubtful Position

The following species belong in *Madurella* but are too poorly described to place more definitely.

Aspergillus mycetomi Villabruzzi & Gelonesi, Annali Med. Nav. Colon. **33**: 283-308, *8 figs.*, 1927.

Isolated from black grain mycetoma in Somaliland. No attempt was made to determine its pathogenicity.

Hyphae 3-4μ in diameter, septate, rarely branched. Spherical or ovoid sporophore swells to form vesicle and is 4-6-spored. Spores spherical, Bismarck brown. No trace of conidia or ascocarps.

Grows rapidly only on banana, very slowly on other media. Colonies small yellowish white masses the size of a lentil or smaller, becoming zonate; yellowish, orange, blackish brown with a white margin.

Madurella Bouffardi (Brumpt) Dodge, n. comb.

Aspergillus Bouffardi Brumpt, Arch. de Parasitol. **10**: 525-533, 1906 [Case described and organism figured by Bouffard, Ann. Hyg. Méd. Colon. **8**: 579-590, *1 pl.*, 1905].

Isolated at Djibouti, Somaliland, from tumors in the adipose tissues of the foot which did not affect the epidermis, muscles, or bones. The anterior third of the foot was globular, but there was no suppuration. The tumors were fibrous, each containing 3-7 black grains embedded in the center, and varying in size from that of a pea to that of a hen's egg. When these were surgically removed, healing was rapid and complete. Source of infection unaccounted for. Inoculations unsuccessful in monkey, dog, cat, and gazelle.

Young mycelium silver white with a brown periphery forming a cortical zone; conidiophore erect, simple, continuous, white, 2μ in diameter with vesicle 4.5μ broad by 6μ tall. Conidia spherical, 1.33-2μ in diameter, smooth, white, in chains. Chlamydospores spherical, 5-10μ broad. Intercalary chlamydospores colorless, terminal ones brownish. Grains are similar to sclerotia except that they are sporiferous within.

Madurella Bovoi Brumpt, Précis Parasitol. ed. 1, 1910.

Aspergillus fumigatus Bovo, Policlinico Sez. Chirurg. **13**: 97, 119, *6 figs.*, 1906.

Isolated from a typical Madura foot with a few granules appearing in the groin.

A grain from the foot was treated with 30% KOH for 12 hours, then kept for 24 hours in distilled water, stored in 80% alcohol for a year, and then treated for 24 hours with 25% KOH. On examination it showed hyphae 4-6μ in diameter, septate. Bovo figured something which looks like a young mucor sporangium, is ovoid and stains with methylene blue. He thought this was a head of *Aspergillus*.

This organism probably should be referred to *M. mycetomi*.

INDIELLA

Indiella Brumpt, Arch. de Parasitol. **10**: 547, 1906.

This genus includes Mucedineae with white thallus, parasitic in a variety of animal tissues (bone, muscle, connective), possessing vegetative hyphae which vary in diameter from 1 to 5 and even 10μ. These hyphae are septate and laterally branched, never secrete a pigment, form grains like the sclerotia which characterize the different species of the genus. In these grains there are present a fairly large number of chlamydospores, usually terminal.

The type species is *Indiella Mansoni* Brumpt.

Indiella Brumpti Pirajá da Silva, Sobre uma nova maduromycose da grãos branchos . . . Thesis Bahía, 1922.

Following description by Gammel, Arch. Derm. Syphilol. **15**: 256, 1927.

Sterile white hyphae at first slender, scarcely septate and about 2μ in diameter, then thicker, up to 7μ in diameter, and septate. Septa variably spaced from 3-15μ apart. White grains are soft, composed of densely packed hyphae, generally spherical and 0.06-0.08 mm. in diameter. Chlamydospores terminal, often spherical.

Indiella Mansoni Brumpt, Arch. de Parasitol. **10**: 545-549, *Fig. 9,* 1906.

This organism is parasitic on man in India.

Mycelium white, quite slender when young, 1.5-2μ in diameter, septate with walls 15-20μ apart. Older hyphae irregular, 3-5μ in diameter, walls 5-10μ apart. Many chlamydospores present, terminal or intercalary, 5-12μ in diameter, generally spherical and unicellular, rarely segmented (Fig. 111). Grains in tissues are very small, flattened, varying from 200-250μ in diameter, often parasitized by bacteria.

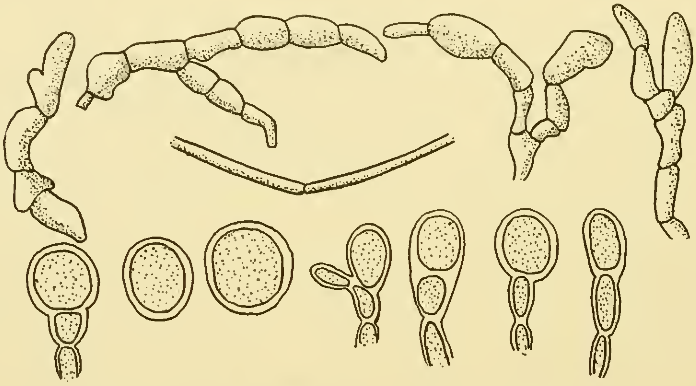

Fig. 111.—*Indiella Mansoni.* (After Brumpt 1906.)

Indiella Reynieri Brumpt, Arch. de Parasitol. **10**: 549-555, *Figs. 10, 11,* 1906.

Organism found parasitic on man in Paris.

Thallus white. Young mycelium septate and slender, 1-1.5μ in diameter, septa 10-15μ apart. Peripheral hyphae 4-5μ in diameter, irregular, moniliform, walls closer than in central hyphae, each terminated by a 2-3-celled chlamydospore, from 5-20μ in diameter. Intercalary chlamydospores rare, grain or sclerotium rounded when young, later becoming like a twisted cord or the excrement of the earthworm and about 1 mm. in diameter.

Doubtful Position

It seems likely that the organism described as *Halobyssus moniliformis* var. *parasiticus* Maffei, Atti Ist. Bot. R. Univ. Pavia IV, **3**: 19-28, *10 figs.,* 1932, belongs in *Indiella,* or if it proves to belong in *Halobyssus,* perhaps that genus should be amended to include *Indiella.* This reference was received too late for critical study of the case history, which is recorded by Barco, P., Granuloma del polso a sede sottocutanea da micete del genere Halobyssus Zukal, Arch. Ital. Chirurg. **29**: 1931, but Maffei summarizes the case.

Isolated from mycetoma of the wrist, Italy.

Hyphae 1-5μ in diameter, hyaline, septate, branched finely granular, forming terminal chains of chlamydospores with a tendency for the terminal spore to be the largest and each successive one smaller until the size of the hyphae is reached. Chlamydospores with thick verrucose walls, 4-14μ, more commonly 10-12μ in diameter.

Growth good on Pollacci agar, a coarsely granular mass slightly floccose, whitish. Growth good in either liquid or solid media.

BIBLIOGRAPHY

Adami, J. George & B. A. Kirkpatrick. 1895. A case of Madura foot disease (mycetoma pedis, ochroid variety), *Trans. Ass. Amer. Physicians* 10: 92-100, *3 figs.*

Agostini, Angela. 1931. Coniosporium isolé d'un cas d'onychomycose, *Boll. Sez. Ital. Soc. Internaz. Microbiol.* 3: 214, 215.

—. 1931. Coniosporium onychophilum n. sp. causa di onicomicosi, *Atti Ist. Bot. R. Univ. Pavia* IV, 3: 29-36.

Aitchison, J. E. Tierney. 1861. Godfrey and Eyre's tubercular disease, *Indian Ann. Med. Sci.* 7: 517-520.

Almeida, Floriano Paulo de. 1932. Considerações sobre o diagnostico histopathologico dos mycetomas, *Revista Biol. Hyg.* 3: 93-95, *Pls. 3-4.*

Anderson, Charles. 1924. Sur un douzième cas de pied de Madura observé en Tunisie, *Arch. Inst. Pasteur Tunis* 13: 68-70.

Anderson, Ch., R. Broc & Cassar. 1926. Deux nouvelles observations tunisiennes de mycétome, *Arch. Inst. Pasteur Tunis* 15: 332-335.

Armand, Delille, P. Duhamel & Marty. 1923. Gommes cutanées et manifestations pulmonaires dues à une mycose d'espèce encore indeterminée, *Bull. Soc. Pédiatr. Paris* 21: 190-193.

Arwine, J. T. & D. S. Lamb. 1899. A fifth case of fungus foot in America, *Am. Jour. Med. Sci.* 118: 393-399, *5 figs.*

Audrain, L. C. 1924. A case of mycetoma, *Jour. Am. Med. Ass.* 83: 1165.

Barreto, Antonio Luiz B. & Carlos Burle Figueiredo. 1919. Da reacção de fixação de complemento no mycetoma podal ou pé de Madura, *Brasil Med.* 33: 403.

Bassini, E. 1888. Un caso di micetoma al piede o Piede di Madura, *Arch. Sci. Med.* 12: 309-318, *Pls. 10-12.*

Bays, James T. 1905. Madura foot in Cape Colony, *S. African Med. Rec.* 3: 75.

Belák, Alexander. 1919. Studien an zwei von v. Verebély aus Madurafüssen gezüchteten Pilzstämmen, *Centralbl. Bakt.* I, 83: 528-530.

Berkeley, Miles Joseph. 1864. Observations on a peculiar mode of fructifications in Chionyphe Carteri Berk., *Jour. Linn. Soc. London Bot.* 8: 139-142, *Pl. 10.*

Beron, B. 1931. Zwei autochtone Fälle von Mycetoma mit schwarzen Körner, *Derm. Woch.* 92: 265-272, *16 figs.*

Blanc, Georges & Gabriel Brun. 1919. Nouveau cas de mycétome à grains noirs observés en Tunisie, *Bull. Soc. Path. Exot.* 12: 741-748, *1 pl.*

Bloch, Bruno. 1916. Über einen Fall von Mycetoma pedis, verursacht durch eine bis jetzt noch nicht beschriebene Streptothrix Art, *Cor. Bl. Schweiz Aerzte* 46: 270, 271.

Bocarro, J. E. 1893. An analysis of one hundred cases of mycetoma, *Lancet* 2: 797, 798.

—. 1895. Mycetoma, *Lancet* 1: 70, 71.

Bockenheimer, Ph. 1909. Einiges über die Behandlung chirurgischer Krankheiten in Asien, *Arch. Klin. Chirurg.* 90: 174-190, *2 pls.*

Borja, Antonio. 1918. Sobre un caso de mycetoma de grãos negros, *Brasil Med.* 32: 221.

Bouffard. 1902. Pieds de Madura observés à Djibouti, *Ann. Hyg. Méd. Colon.* 5: 636-652.

—. 1905. Mycetoma à grains noirs en Afrique, *Ann. Hyg. Méd. Colon.* 8: 579-590.

Boyd, Mark F. & Earl D. Crutchfield. 1921. A contribution to the study of mycetoma in North America, *Amer. Jour. Trop. Med.* 1: 215-289.

Brault, J. 1912. Mycétome à grains noirs observé en Algérie, isolement du Madurella mycetomi, *Ann. Derm. Syphiligr.* V, 3: 333-343.

—. 1913. Note sur les cultures de Madurella mycetomi, *Bull. Soc. Path. Exot.* 6: 407-409.

Brault, J. & Lucien Masselot. 1912. Mycose du pied à grains noirs chez un jeune indigène algérien, *Arch. de Parasitol.* 15: 218-225, *4 figs.*

Brown, Grafton Tyler. 1932. Sensitization to fungi, *Ann. Intern. Med.* 6: 655-671.

Bruas. 1903. Pied de Madura à grains noirs observé à Madagascar, *Ann. Hyg. Méd. Colon.* 6: 602-605.

Brumpt, Émile. 1902. Notes et observations sur les maladies parasites. 10. Mycétome à grains noirs, *Arch. de Parasitol.* 5: 151-156, 460. 11, Mycétome à grains blancs, *Ibid.* 5: 156-158.

—. 1905. Sur le mycétome à grains noirs, maladie produite par une mucédinée du genre Madurella n.g., *C. R. Soc. Biol.* 57: 997-999.

—. 1906. Les mycétomes, *Arch. de Parasitol.* 10: 489-572, *10 pls.* [*Thèse Fac. Méd. Paris*, 94 pp., *10 pls.*]

Brumpt, Émile, Bouffard & J. A. Chabaneix. 1901. Notes sur quelques cas de paludisme et sur un cas de mycétome observés à Djibouti, *Arch. de Parasitol.* 4: 564-567.

Burnet, Etienne & Gabriel Brun. 1926. XVIIe observation tunisienne de mycéetome, *Arch. Inst. Pasteur Tunis.* 15: 151-153.

Canal Feijoó, E. J. & R. Barrionuevo. 1932. Un nuevo caso de micetoma con granos negros en Santiago del Estero, *Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán* 7: 496-500, *6 figs.*

Carter, Henry Vandyke. 1863. On mycetoma, *Brit. Foreign Med. Chir. Rev.* 32: 198-203.

—. 1873. The parasitic fungus of mycetoma, or the fungus of India, *Trans. Path. Soc. London* 24: 260-263.

—. 1874. On mycetoma or the fungus disease of India, London xi, 118 pp. *11 pls.*

—. 1874. On the nature of mycetoma, or the fungus disease of India, *Lancet* (London) 2: 44-46; 113-115.

Catanei, A., Grosdemange & Ch. Legroux. 1927. Sur un cas de mycétome du pied observé en Algérie, *Bull. Soc. Path. Exot.* 20: 11-13.

Castellani, Aldo. 1925. Notes on non-gonorrhoeal urethrites, *Jour. Trop. Med. Hyg.* 28: 250-252.

Catsaras, Johannes. 1912. Zwei Fälle von Madurafuss (Mycetoma pedis) in Griechenland, *Arch. Schiffs-Tropenhyg.* 16: 461-474, *Pl. 2.*

—. 1915. Bemerkungen über neue Fälle von griechischen Myzetom, *Arch. Schiffs-Tropenhyg.* 19: 617-625.

Chabaneix, J. A. & Bouffard. 1901. Pieds de Madura observés à Djibouti, *Ann. Hyg. Méd. Colon.* 4: 452-456.

Chalmers, Albert J. & R. G. Archibald. 1918. The classification of the mycetomas, *Jour. Trop. Med. Hyg.* 21: 121-123.

—. 1916. A Sudanese maduromycosis, *Ann. Trop. Med. Parasitol.* 10: 169-222, *Pl. 4-7.*

—. 1917. Mycetoma and pseudomycetomatous formations, *New Orleans Med. Surg. Jour.* 70: 455-475.

Chatterjee, G. C. 1911. On the biology of black mycetoma, *Indian Med. Gaz.* 46: 376-378.

—. 1911. On the cultivation of black variety of mycetoma, *Centralbl. Bakt.* I, 61: 358-365, *Pls. 1, 2.*

Chmielewski. Paul. 1921. Contribution à l'étude des mycétomes de l'afrique du nord et du diagnostique général des Mycétomes, *Thèse Univ. Alger. Fac. Med. Pharm.* 16: 1-64.

Ciferri, Rafaelle and Bailey K. Ashford. 1929. Two strains of Pullularia pullulans (de Bary) Berkhout isolated from the human skin, *Porto Rico Jour. Public Health Trop. Med.* 5: 188-195.

Clamann. 1924. Charakteristische Pilzformen (Befällungspilze, Schwärzepilze) auf der Haut der Landbevölkerung, *Derm. Woch.* 78: 584-586, *2 figs.*

Clemow, Frank G. 1906. Mycetoma (Madura foot) in the Yemen, *Brit. Med. Jour.* 1: 918, 919, *3 figs.*

Collas. 1883. La maladie de ballingall (pied du Maduré) d'après des notes inédites du docteur Collas . . . à Pondichéry mis en ordre complétées et annotées par . . . A. Corre, *Arch. Méd. Nav.* 39: 81-137, 204-224.

Coquerel, Charles. 1866. Note sur l'examen microscopique des lésions que l'on observe dans l'affection connue sous les noms de pérical, pied de Madura, *Mém. Soc. Biol.* 17: 191-196.

Corre, A. 1883. See also Collas. 1883.

Cunningham, D. D. 1895. Is mycetoma primarily owing to the action of the fungal elements ordinarily associated with its products? *Sci. Mem. Med. Off. India* 9: 67-74, *Pls. 1, 2.*

Delamare, G. & C. Gatti. 1929. Hyphomycète cultivable à grains blancs reniformes et durs, Indiella americana, *C. R. Acad. Sci.* 188: 1264-1266, *3 figs.*

—. 1931. Mycétome du pied à grains noirs, *Bull. Soc. Path. Exot.* 24: 80-84, *3 figs.*

Etienne, G. 1920. Mycoses et mycétomes, *Rev. Mèd. de l'Est* (Nancy) 48: 1-11.

Falchi, G. 1925. Onicomicosi da Hemispora stellata, *Giorn. Ital. Derm. Sifilol.* 66: 650-656, *1 pl.*

Ferrari, Angelo. 1932. Ricerche sul Cryptococcus metaniger Cast., *Atti Ist. Bot. R. Univ. Pavia* IV, 3: 175-184, *3 figs.*

Fonseca Filho, Olympio Oliveira Ribeiro da. 1930. O genero Madurella e os mycetomas produzidos pelas especies nelle contidas, *Rev. Med. Cirurg. Brasil* 38: 262-269, *2 figs.*

—. 1930. As chromoblastomycoses, *Rev. Med. Cirurg. Brasil* 38: 197-216, *3 pls.* [English translation 216-236.]

Fonseca Filho, Olympio Oliveira Ribeiro da & A. E. da Arêa Leão. 1927. Contribuição para o conhecimento da Hemispora stellata, *Sciencia Med.* 5: 584-587, *1 pl., 2 figs.* [A contribution to the knowledge of Hemispora stellata, *Ibid.* 5: 587, 588.]

—. 1927. Contribution à l'étude d'Hemispora stellata, *C. R. Soc. Biol.* 97: 1790-1792, *2 figs.*

Fonseca Filho, Olympio Oliveira Ribeiro da, A. E. da Arêa Leão & J. J. C. Nogueira Penido. 1927. Mycose de type ulcéro-nodulaire, semblable à la sporotrichose et produite par Hormodendrum Langeroni, *C. R. Soc. Biol.* 97: 1772-1774, *2 figs.*

Fonseca Filho, Olympio Oliveira Ribeiro da & A. Ferreira da Rosa. 1930. Sobre a 'keratomycosis nigricans palmaris,' *Rev. Med.-Cir. Brasil* 38: 337-344, *1 pl.*

—. 1930. Sur Cladosporium Wernecki et la keratomycose nigricans palmaire, *C. R. Soc. Biol.* 105: 785, 786.

Fox, Tilbury. 1870. Fungus foot of India, *Trans. Path. Soc. London* 21: 411, 412.

—. 1871. Fungus foot of India [pathology by J. S. Bristowe], *Trans. Path. Soc. London* 22: 320-326, *Figs. 29-32.*

—. 1876. The so-called "Fungus-foot" of India, *Lancet* 1: 190, 191.

Froés, Heitor Praguer. 1930. Do mycetoma pedis no Brasil . . . Monographia contendo varios quadros e mappas estatisticos e documentada con 60 microphotographias originaes, além de 36 photographias diversas, algumas tambem originaes e em grande parte inéditas. A Nova Graphica, Bahia, 300 pp., *47 pls.*

—. 1931. Mycetoma pedis (Madura foot) and its incidence in Brazil, *Jour. Trop. Med. Hyg.* 34: 376-378, *2 pls.*

—. 1932. Mycetoma pedis ou Mycetoma podal, *Jornal dos Clinicos,* 3-17.

Fulleborn, F. 1911. Madurafuss aus Deutsch-Südwestafrica, *Arch. Schiffs-Tropenhyg.* **1**: 131-133.

Gammel, J. A. 1927. The etiology of maduromycosis, *Arch. Derm. Syphilol.* **15**: 241-284, *20 figs.*

Gammel, J. A., Hagope Miskdjian & Harvey S. Thatcher. 1926. Madura foot (mycetoma), the black grain variety in a native American, *Arch. Derm. Syphilol.* **13**: 66-77, *6 figs.*

*Gastaminza. 1929. *Med. de los Paises Calidos* **2**: 445.

Gelonesi, Gregorio. 1927. Due nuovi parassiti del piede di Madura. Studio sui micetomi della Somalia meridionale, *Ann. Med. Nav. Colon.* **33**: 283-308, *8 figs.*

Guiart, J. 1920. Considérations sur le mycétome à propos d'un cas nouveau, *C. R. Soc. Biol.* **83**: 277, 278.

Hatch, William K. & F. L. Childe. 1894. A remarkable case of mycetoma, *Lancet* **72**: **2**: 1271-1273.

Hirsch, August. 1863. Der Madura-Fuss. Ein Beitrag zur geschichte des pflanzlichen Parasitismus, *Arch. Path. Anat. Physiol.* [Virchow] **27**: 98-115.

*Hoffmann, W. H. 1928. La cromoblastomicosis en Cuba y la enfermedad de Guiteras o "Chappa," *Rev. Méd. Cub.* **39**: 420.

Hogg, Jabez. 1872. Mycetoma: the fungus-foot of India, *Monthly Microsc. Jour.* **7**: 98-100.

—. 1872. Fungus-foot disease of India, *Trans. Path. Soc. London* **23**: 294-297.

Horta, P. *See* Parreiras Horta, P.

Huntly, William. 1889-1890. Case of Madura foot in its initial stage, *Glasgow Med. Jour.* **32**: 344-346; **33**: 339-342.

Jeanselme, E., L. Huet & Lotte. 1928. Nouveau type de mycétome à grains noirs du à une Torula encore non décrite, *Bull. Soc. Franç. Derm. Syphiligr.* **35**: 369-375, *3 figs.*

Jones, Jack W. & Herbert S. Alden. 1931. Maduromycotic mycetoma (Madura foot). Report of a case occurring in an American negro, *Jour. Amer. Med. Ass.* **96**: 256-260.

Kemper, G. W. H. 1876. A case of podelcoma: with microscopic examination of the diseased structure by Henry Jameson, *Am. Practitioner* **14**: 129-135.

Köbner. 1891. Pilzpräparat von Madurafuss (Mycetoma pedis) aus Italien, *Berlin. Klin. Woch.* **28**: 132.

Kyriasides, K. N. 1929. Die in Griechenland bei Madurafuss (Mycetoma pedis) gefundenen Pilzarten, *Arch. Schiffs-Tropenhyg.* **33**: 656-660.

—. 1930. Champignons des mycétomes observés en Grèce, *Ann. Parasitol. Hum. Comp.* **8**: 194-200.

Langeron, Maurice. 1928. Mycétome a Torula Jeanselmei Langeron, nouveau type de mycétome à grains noirs, *Ann. Parasitol. Hum. Comp.* **6**: 385-403, *12 figs.*

Langeron, Maurice & P. Parreiras Horta. 1922. Note complémentaire sur le Cladosporium Wernecki Horta 1921, *Bull. Soc. Path. Exot.* **15**: 381-383.

Laveran, Alphonse. 1902. An sujet d'un cas de mycètoma à grains noirs, *Bull. Acad. Méd. Paris* III, **47**: 773-776, *1 fig.*

LeDantec, A. 1894. Étude bactériologique sur le pied de Madura du Sénégal (variété truffoide), *Arch. Méd. Nav. Colon.* **62**: 447-454.

Mackenzie, K. W. 1911. A case of Madura foot, *Indian Med. Gaz.* **46**: 378-380.

*McMurray, W. & Norman Paul. 1914. Tinea albigena, a fungus near Trichophyton albiscicans Nieuwenh, *Australasian Med. Cong. 10th Sess. Auckland*, 629.

Madden, Frank Cole. 1902. Two cases of the pink variety of mycetoma, *Jour. Trop. Med. Hyg.* **5**: 243, 244.

Maffei, L. 1931. Micosi causata da una varietà di Halobyssus moniliformis Zukal, *Atti Ist. Bot. R. Univ. Pavia* IV, **3**: 19-28, *10 figs.*

Magalhães, Pedro Severiano de. 1921. Hyphomycetoma (nova mycosa) Rio Janeiro 1914, *Centralbl. Bakt.* **72**: 94, 95.

Maitland, J. 1898. Case of mycetoma of the abdominal wall, *Indian Med. Gaz.* 33: 57-59, *1 fig.*

Mazza, Salvador & E. J. Canal Feijoó. 1931. Micetoma de granos negros por Madurella sp. del Chaco santiagueño, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 244-254, *10 figs.* [*6ta Reunión Soc. Argentina Patol. Reg. del Norte, Salta,* 1930].

Minas, P. 1861. [Two] cases of tubercular disease of the foot, *Indian Ann. Med. Sci.* 7: 521, 522.

Monnier. 1918. Au sujet d'un pied de Madura observé à Fort Dauphin, Madagascar, *Bull. Soc. Path. Exot.* 11: 407-416.

Montpellier, Pierre Jean Marie, 1914. Les mycoses et les pseudomycoses du pied en Algérie, *Thèse Bordeaux* 101: 90 pp.

Montpellier Jean, P. Gouillon, & A. Lacroix. 1921. Nodule mycétomique du bras; inoculation par épine, *Bull. Soc. Franç. Derm. Syphiligr.* 28: 347-349.

Musgrave, W. E. & M. T. Clegg. 1907. The etiology of mycetoma: report of a case of the ochroid variety occurring in the Philippine Islands and caused by a new species of Streptothrix (Streptothrix Freeri), *Philippine Jour. Sci. B.* 2: 477-511, *Pls. 1-4.*

Newman, J. H. 1874. [Four] cases of Madura foot disease, *Indian Med. Gaz.* 9: 322, 323.

Nicolle, Charles & Georges Blanc. 1920. Sur les divers cas de mycétome (pied de Madura) observés jusqu'à ce jour en Tunisie, *Arch. Inst. Pasteur Tunis* 9: 183-224, *7 figs.*

Nicolle, Charles & E. Pinoy. 1907. Sur la fructification des pathogènes à l'intérieur même des tissues chez l'homme, *C. R. Acad. Sci.* 144: 396, 397.

—. 1908. Un cas de mycétome à grains noirs; culture et inoculation expérimentale, *Bull. Soc. Path. Exot.* 1: 95-99.

Noc, F. & Jouenne. 1922. Les mycétomes à grains noirs du Sénégal, *Ann. Inst. Pasteur* 36: 365-385.

Onorato, Raffaele. 1926. I micetomi in Tripolitania, *Arch. Ital. Sci. Med. Colon.* 7: 1-8, 33-50, 65-83, 97-110, 137-152.

Oppenheim, Moriz. 1904. Die pathologische Anatomie des indischen Madurafusses (Mycetoma pedis), *Arch. Derm. Syphilis* 71: 209-242, *Pls. 17-20.*

Palmer, F. J. 1926. A case of Madura foot treated by chemotherapy; apparent cure, *Indian Med. Gaz.* 61: 74.

*Parreiras Horta, P. 1919. Um novo mycetoma de grãos negros produzido pela ''Madurella Oswaldoi, n. sp.'' *A Pathologia Geral,* No. 1-4.

—. 1921. Sobre um caso de tinha preta e um novo cogumelo (Cladosporium Wernecki), *Rev. Med. Cirurg. Brasil* 29: 269-274.

Patton, W. S. 1906. Mycetoma (Madura foot) in the Yemen, *Brit. Med. Jour.* 1: 1401.

Pelletier, J. F.: 1906. Mycétome à grains rouges observé à Saint Louis (Sénégal), *Ann. Hyg. Méd. Colon.* 9: 578-580, *1 fig.*

Peña, Raul. 1930. À propos d'un cas de mycétome à grains blancs observé à Assomptión (Paraguay) et produit par le Scedosporium apiospermum, *C. R. Soc. Biol.* 104: 689, 690.

—. 1930. A proposito de um caso de mycetoma podal de grâos brancos observado em Asunçión, produzido pelo Scedosporium apiospermum, *Rev. Med. Cirurg. Brasil.* 38: 142-145, *1 fig.* [English translation 145-147].

Pinoy, E. 1912. Note, *Ann. Derm. Syphiligr.* V, 3: 341-343.

—. 1913. Actinomycoses et mycétomes, *Bull. Inst. Pasteur* 9: 929-938, 977-984.

Pirajá da Silva [Paulo]. 1918-19. Contribuição à micologia parasitária do Brasil. Duas novas espécies de fungos productores de maduromicose, *Mem. Inst. Butantan* 1: 187-207, *Pls. 34-38.*

—. 1919. Duas novas especies de fungos productores de maduromycose no Brasil, *Brasil Med.* 33: 81-83.

*—. 1922. Sobre uma nova maduromycose de grãos brancos produzida pelo Indiella Brumpti, n. sp. *Tesis Bahia.*

Plehn, A. 1927. Madurafuss (Mycetoma pedis), *Handbuch Path. Mikroorg.* [Kolle & Wassermann, ed. 3] 5: 113-132, *1 pl.*, *4 figs.*

Polverini, G. 1903. Ricerche e ossevazioni sul piede di Madura, *Lo Sperimentale* 57: 659-684.

Pope, Benjamin T. & D. S. Lamb. 1896. Mycetoma, the fungous foot of India, *N. Y. Med. Jour.* 64: 386-388.

Porcelli, Rodolfo. 1922. Hemisporosi cutanea. Dimostrazione della Hemispora stellata nei tessuti, *Pathologica* 14: 496, 497, *1 pl.*

—. 1922. Micosi cutanea da Hemispora stellata (Vuillemin). Primo caso in Italia, *Giorn. Ital. Mal. Ven. Pelle* 63: 698-709, *1 pl.*

Prado Valladares. 1916. Pityriasis nigra centro albicans (Pitirase negra de despigmentacão central), *Brasil Med.* 30: 137, 138, *1 fig.*

Prasad, K. 1906. Notes on a case of fungus disease of India (Mycetoma or Madura foot), *Indian Med. Gaz.* 41: 139, 140.

Puyhaubert, A. & Robert Jolly. 1918. Note sur un cas de mycétome à grains noirs provoqué par un champignon du genre ''Madurella,'' *Arch. Méd. Expér.* 28: 441-445.

—. 1919. Note sur un cas de mycétome à grains noirs, *Bull. Soc. Path. Exot.* 12: 57-60, *Figs. 1-3.*

—. 1920. Note sur un cas de mycétome à grains noirs provoqué par un champignon du genre Madurella, *Rev. Méd. de l'Est* 48: 11-15, *6 figs.*

Reenstierna, J. 1926. Réproduction expérimentale du mycétome, *Arch. Inst. Pasteur Tunis* 15: 101-107, *1 pl.*

Reynier, Paul. 1906. Présentation d'un moulage, de coupes microscopiques et de photographies d'un pied de Madura, *Bull. Mém. Soc. Chir. Paris* 32: 618-623, *5 figs.*

Reynier, Paul & Emile Brumpt. 1906. Observation parisienne de Pied de Madura, *Bull. Acad. Méd. Paris* III, 55: 709-723, *9 figs.*

Rietmann, Br. 1930. Note préliminaire sur une épidermomycose palmaire noire observé dans l'Etat de Bahia au Brésil. *Bull. Soc. Franç. Derm. Syphiligr.* 37: 202-207, *5 figs.*

Robin, Charles. 1863. Note sur le pied endémique de Madura, *Gaz. Méd. Paris* III, 18: 461.

—. 1864. Note sur le pied endémique de Madura, *C. R. Soc. Biol.* 15: 34.

Ruelle, Edmond. 1893. Contribution à l'étude du mycétome, *Thèse Fac. Méd. Pharm. Bordeaux* 6: 1-83.

Sakurane, J. 1906. Ein Fall von Oidiomycosis der Haut und des Unterhautzellgewebe, *Arch. Derm. Syphilis* 78: 211-221.

Sartory, Antoine, M. Meyer & Jacques Meyer. 1930. Contribution à l'étude des mycoses osseuses; trois cas d'ostéites dues d'une part à l'actinomyces asteroides (Eppinger) et d'autre part a l' Hémispora stellata, *Ann. Inst. Pasteur* 44: 298-329, *8 figs.*

Sartory, Antoine, R. Sartory, Br. Rietmann & Jacques Meyer. 1930. Contribution à l'étude d'une épidermomycose brésilienne palmaire noire, provoquée par un Cladosporium nouveau, *C. R. Soc. Biol.* 104: 878-881.

Semon, H. C. 1915. Mycetoma pedis, *Brit. Jour. Derm. Syphilis* 27: 299-303, *Pl. 8.*

Shattock, Samuel G. 1897, 1898. Mycetoma papillomatosum, *Trans. Path. Soc. London* 49: 293-296, *1 pl.;* also *Brit. Med. Jour.* 1: 622.

Silva, Flaviano. 1929. Contribuição para o estudo do mycetoma podal na Bahia, *Sciencia Med.* 7: 153-164, *6 figs.* [Rev. *Brasil Med.* 43: 635, 636].

—. 1929. Tinea nigra (Cladosporose epidermica), *Brasil Med.* 43: 924-926.

Silva, Pirajá. *See* Pirajá da Silva.

Smyth, J. 1898. Notes on a case of mycetoma of the neck, *Indian Med. Gaz.* 33: 56, 57, *1 fig.*

Surveyor, Nusserwangi F.: 1892. Madura foot of India, *Brit. Med. Jour.* 2: 575, 576.

Thompson, Harold L. 1928. The present status of mycetoma, *Arch. Surgery* 16: 774-788.

Thompson, Harold L. & Kano Ikeda. 1928. Maduromycosis: fourth case reported in the United States, *Arch. Surgery* 16: 764-773, *10 figs.*

Towey, John W., Henry C. Sweany & Willis H. Huron. 1932. Severe bronchial asthma apparently due to fungous spores found in maple bark, *Jour. Amer. Med. Ass.* 99: 453-459, *7 figs.*

Vuillemin, Paul. 1906. Un nouveau genre de Mucedinées: Hemispora stellata, *Bull. Soc. Myc. France* 22: 125-129, *Pl. 7.*

—. 1919. Remarques sur les mycétomes: hommage à la mémoire de M. [R.] Jolly, *Arch. Méd. Exp. Nat. Path.* 28: 446-451; also *Rev. Méd. de l'Est* 48: 15-20.

Wright, James H. 1898. A case of mycetoma (Madura foot), *Jour. Boston Soc. Med. Sci.* 2: 128-130, *1 pl.*

—. 1898. A case of mycetoma (Madura foot), *Trans. Ass. Amer. Physicians* 13: 471-482, *2 fold. pls.*

—. 1898. A case of mycetoma (Madura foot), *Jour. Exp. Med.* 3: 422-433, *Pls. 39, 40.*

*Yazbek, Alexandre Kalil. 1920. Dos Mycetomas, *Thèse Inaugural Secção de Obras do ''Estado de São Paulo,''* 164 pp., *26 pls.*

CHAPTER XX

ACTINOMYCETEAE

The systematic position of this group of organisms has long been questioned. Since the mycelium is usually much more slender than that of other groups of fungi and the arthrospores are often bacilliform and of approximately the same magnitudes as bacteria, many bacterial systematists have included this order in the Schizomycetes, often adding *Mycobacterium* and *Corynebacterium* to the group. On the other hand, mycologists who have had occasion to work with the group (Bary, Thaxter, Sauvageau & Radais, Gasperini, Drechsler) have always included them in the Fungi Imperfecti along with the Hyphomycetes. The arguments of the bacteriologists have usually been based on the staining reactions, development of clavate elements in the animal body with *Actinomyces,* representing either the primitive stage from which *Mycobacterium* and *Corynebacterium* form degeneration stages or the culmination from increased production of mycelium. Witter (1933) points out that he was unable to find either chitin or a definite nucleus in the species he studied.

On the other hand, the mycologists have held that the spore production of *Actinomyces* is essentially similar to that of the conidial production of the imperfect fungi, which has nothing in common with bacterial structures, and that many of the apparent resemblances are the result of careless technic. Drechsler (1919) has perhaps given the most careful attention to the morphology of the group, and we owe much of our knowledge of the group to his work. It is to be regretted that his subsequent duties in the Department of Agriculture have prevented his continuing the study of this group and that he has been unable to turn his rich experience in the morphology of the group to the presentation of a systematic account. Only one who has worked with the group from the standpoint of its morphology for a considerable time is really competent to evaluate the conflicting accounts in the literature and to make the necessary assumptions and correlations in filling the lacunae of imperfect descriptions. In the following account, the material is frankly a compilation of the literature, in the hope that this may lead to a keener realization of the lacunae in our present knowledge.

The mycelium of *Actinomyces* has very slender filaments, commonly 0.2-1.0μ in diameter, rarely up to about 1.5μ. It is generally sparsely and irregularly septate, occasionally somewhat regularly septate, but even then less so than in the other Fungi Imperfecti. Branching is common, probably never truly dichotomous, although in a few species it is impossible to be certain. Usually a lateral bud develops at some distance back of the growing tip and may give rise to other branches by lateral proliferation. If these proliferations start close to the tip so that it is difficult to decide which is the main axis, the branching is said to be **dichotomous.**

The branches forming the periphery of the actively growing pellicle or the young sporogenous branches attached at intervals to the superficial mycelium, are filled with a dense protoplasm which takes a deep homogeneous stain with hematoxylin. Nearer the origin of the hyphae the contents appear vacuolate. When the vacuoles are excessively large and extend throughout most of the cross-section of the cell, the cytoplasm is confined largely to the walls, leading some of the earlier writers to refer to the *Aussenplasma* and the *Innenplasma.* The presence of large vacuoles is often associated with local distentions of the hyphal wall, each swollen segment being largely occupied by a single ellipsoid vacuole, separated from the vacuole of the neighboring distention by a protoplasmic partition at the constriction. In other species and in the nutritive mycelium generally there is no marked regularity in the alternation of inflated portions and constrictions, but pronounced deviations in the diameter of the filaments may occur with more or less variable frequency.

Much importance has been attributed by earlier writers to a variety of abnormalities and products of degenerative changes occurring in the mycelium. In the publications of Israel (1878), Johne and MacFadyean (1889), bodies described as *micrococci, cocci,* etc., were given minute attention and assigned an important rôle in the complex ontogeny ascribed to the parasite, supposed to be a pleomorphic bacterium. Wolff and Israel (1891) confused them with the spores of other authors, and as the structures did not have the heat resistance of bacterial spores, they questioned the formation of true spores by *Actinomyces.* Since they figure only sterile mycelium, it is probable that they were correct in their observations. Bostroem, on the other hand, had both true spores and endogenous granules, which he indiscriminately referred to as spores.

Round granules, deeply stained in the living filament by very dilute methylene blue, are variable in size and have a method of multiplication and orientation related to the regions of growth in the mycelium. These were called nuclei by Neukirch. Schütze, using Neukirch's methods, designated them as metachromatic granules. This material is easily distinguished by its powerful affinity for most of the ordinary laboratory stains. In material fixed in alcohol and stained with Delafield's hematoxylin, these granules retain the stain after it has been washed from all other portions of the cell. These granules are rare in the regions of active growth, but in the vacuolated portions they are found as minute bodies widely separated from one another. Farther from the tip of the hypha the granules increase in size and frequency, and their arrangement becomes more regular. The individual spherical bodies are nearly equal in size, exactly filling the lumen of the hypha, and are separated by nearly equal spaces. In other cases, the granules seem to coalesce to form incomparably larger masses, making it difficult to believe that they have any relation to spores or to nuclei. Quite possibly this represents a waste product, since its abundance is always connected with advanced degeneration.

While the mycelium is very uniform throughout the genus, there is very great diversity in spore formation. The spores are developed by a transformation of more or less specialized hyphal branches, early distinguishable from sterile hyphae of the aerial mycelium. In general, the diameter of any portion of sterile mycelium is attained at the time it arises through the elongation of the growing hyphal tip. The sporogenous branches are, in the beginning, conspicuously thinner than the axial hyphae from which they are derived. Later, when they have reached nearly their full length, they increase in thickness, the extent of this varying much with individual species.

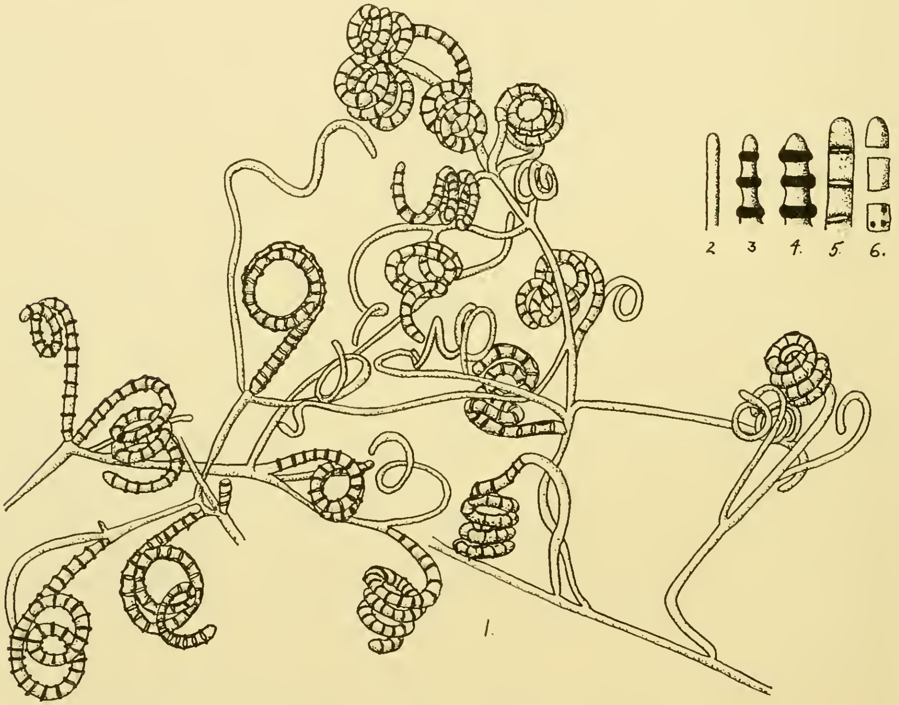

Fig. 112.—*Actinomyces II* isolated from soil. *1*, portion of aerial mycelium, showing conspicuous septa in fertile branches and the relation of the latter to axial filaments; *2-6*, stages in the development of a fertile hypha (×2,750). (After Drechsler 1919.)

In most species the maturation of the sporogenous hyphae is associated with a peculiarity in growth by which they become coiled in more or less characteristic helices. The tendency toward a coiled condition is usually clearly manifest before the branch has grown to half its length through the open flexuous habit of the young filament. As elongation continues, the turns become increasingly definite, but the contraction leading to the final condition, which ranges from *Actinomyces XIII,* with its open, barely perceptible turns, to one in which the helix is so strongly compressed that its adjacent turns are in continuous contact, is usually delayed until the later growth in thickness by the sporogenous filament. Specific differences may not only be indicated by the obliquity of the helix, but involve also the number and diameter of its turns and its construction with reference to a dextrorse or sinistrorse condition. The range in different species extends from two or three turns in *Actinomyces II* (Fig. 112) to over twenty turns in others, the range in an individual species being much smaller. Coils of over twelve turns are very rare. The diameter of the helix is more or less inversely proportional to the number of turns characteristic of the species.

Rotation in the formation of the helix is specifically sinistrorse or dextrorse in different species, the sinistrorse condition being the more common as is general in plants. For a given species the condition of rotation of the helix is constant.

Two main types of branching of sporogenous filaments from the main axis are evident; the erect or dendroid type, in which the sporogenous hyphae are successively developed, and the prostrate racemose type, in which development is more or less simultaneous. In the erect type, the development of the fructification starts from a single erect hypha with a helical termination. Sporogenesis starts at the tip by the insertion of regularly placed septa and proceeds downward toward the base of the filament. Usually, before much of the hypha has been involved, a single septum will appear well toward this base, and immediately below it a bud of a new sporogenous hypha appears. As the latter is attaining its growth in length and thickness and its helical disposition, the basipetal septation in the axial filament proceeds to the septum above the insertion of this first branch, the young spores thus delimited undergo maturation processes, the helix becomes relaxed and the chain of spores subject to disruption. The branch now passes through the same stages of development as the axial hypha and in turn gives rise to a sporogenous branch below a septum a little above its own insertion. The number of sporogenous branches developed below a single septum is generally increased by subsequent proliferations, and the initiation and development of successive orders may be indefinitely repeated. Complex fructifications are frequently developed in which a succession of the processes described are occurring simultaneously at many points.

In the second type, there is no such clearly defined relation between younger and more mature sporogenous hyphae. Development of a fructification is initiated by the proliferation of branches at irregular intervals on the distal portion of a prostrate axial filament which often exceeds 1 mm. in length (Fig. 113). The branches may either cease their more extensive development after forming a helix or themselves proliferate a secondary branch a short distance above their own insertion, and this in turn may form a helix and give rise to a tertiary branch. By repetition of this process, each lateral element may become branched several times, the whole apparatus as well as its insertion on the axial filament being characterized by an absence of septa. Sporulation, instead of beginning in any individual helix as soon as it is formed, is usually delayed until the branching and growth of helical hyphae in the same lateral process have come to an end, when it will often proceed rapidly and almost simultaneously in all the helices. The termination of the axial filament itself develops into a helix and behaves essentially like a primary lateral branch.

Occasionally, the axis of one of these racemose arrangements may be comparatively short, resulting in a rather intricate structure where one lateral branch may be entangled with another. The tendencies characteristic of the type, namely, the absence of a septum above the insertion of branches, and the delay in sporulation in the helices first formed, are maintained, however, until the growth of the last order of sporogenous branches is more or less complete.

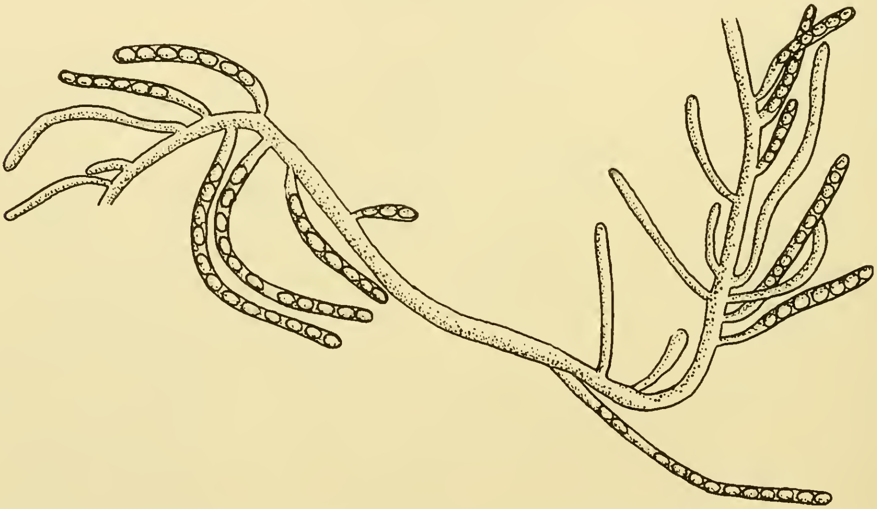

Fig. 113.—*Actinomyces XVIII.* Portion of fructification bearing aberrant fertile branches without spiral terminations (×2,750). (After Drechsler 1919.)

Besides species in which these two types are distinct, there are a large number of species in which there is a combination of these two methods. Frequently the open racemose arrangement of the lateral branches on the main axial filament is associated with a successive order of development in the further ramification. The presence of a septum above the insertion of a branch is characteristic of more species than is its absence, and in some species both conditions prevail.

In a few species there are formed, besides the more regular fructifications, others with relatively thick branching axial hyphae which are densely filled with protoplasm and bear, at very close and irregular intervals, a short thick unbranched sporogenous hypha with little or no helical modification. This seems to be associated with excessively rapid growth (e.g., *Actinomyces albus*, Fig. 114).

The prevailing idea, that most of the mycelium is converted into spores, is incorrect. Sporulation is strictly confined to terminal elements, never as a rule passing beyond the first junction with another element (Fig. 115). The proliferation of a branch nearest the end of the axial filament limits spore production in this filament to the portion beyond the insertion of the first branch; in the same manner, the proliferation of a secondary from a primary lateral branch results in a sterilization of the portion of the hypha below the insertion of the new branch. In *Actinomyces V*, sporulation is even further restricted by the apparent abortion of a number of potential spores at the proximal end of the unbranched lateral branches. The hyphal portion which is involved first develops as usual, but when the characteristic septation associated with the delimitation of spores in this species appears in the helix, it is not extended to the base of the branch, although indications of regularly spaced membranes may usually be distinguished. Later, the unsegmented

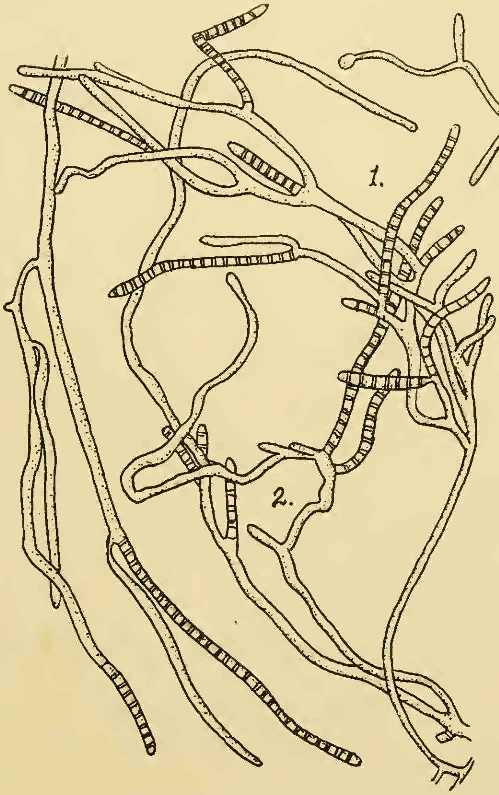

Fig. 114.—*Actinomyces albus* (*A. griseus* Krainsky ?). *1, 2,* portions of aerial mycelium; *3,* germinating spore (×2,750). (After Drechsler 1919.)

portion is gradually evacuated and converted into a sterile stalk devoid of protoplasm. It is interesting to note that the basal septum which in an allied and very similar form, *Actinomyces VI,* delimits the lowest spore from the axial filament, here also is present as a well-developed septum.

The delimitation of the ultimate cells in the process of sporulation occurs usually as the growth in thickness and the contraction of the helix are approaching completion. It has usually been believed that the details connected with the spore formation are uniform throughout the genus, but this is not universally true. In most species, the sporogenous hyphae become divided into regular cylindric cells separated by septa; the latter generally stain deeply with Delafield's hematoxylin, probably as a result of an association with metachromatic or possibly nuclear material. These species may be subdivided into three groups.

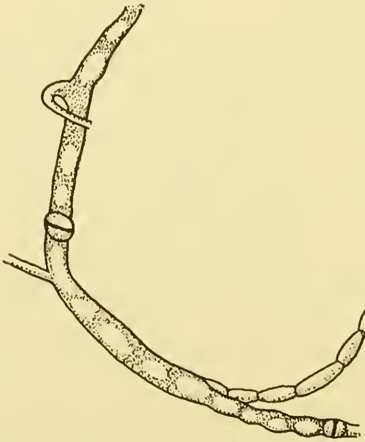

Fig. 115.—*Actinomyces XVIII.* Degenerate axial filament containing large vacuoles and spherical structures and bearing a fertile helix (×2,750). (After Drechsler 1919.)

In the first group (e.g., *Actinomyces I*), the cross walls in the sporogenous hyphae remain without any very pronounced change, continuing to separate the adjacent cells until these have developed into a chain of mature contiguous spores. The insertion of these septa progresses from the tip toward the base and does not break the physiologic continuity of the hyphae, for food material apparently is transmitted through them to the young spores at the termination, since these subsequently increase in size and may deposit a wall of measurable thickness.

In the second group, the septa split into halves, which are then drawn apart by the longitudinal contraction of the individual protoplasts. In *Actinomyces II,* the very pronounced growth in thickness of the sporogenous hyphae, following the insertion of septa, indicates that in this species also septation brings about no impediment in the transfer of food material. This is remarkable in view of the extraordinary thickness of the septa characterizing this species. *Actinomyces scabies* probably represents the more usual condition where the segment of the hyphal wall evacuated by the contraction of each two successive spores undergoes no change until fractured by the disruption of the chain of mature spores.

In the third group, as in *Actinomyces aureus*, the septa first undergo a deep constriction which, by involving the ends of the young cylindric spores, gives to the latter an elongated ellipsoid shape (Fig. 116). The constricted septum now gradually loses its staining properties and appears to be slightly drawn out in a longitudinal direction. A preparation stained with Delafield's hematoxylin usually shows many old spore chains in which the individual

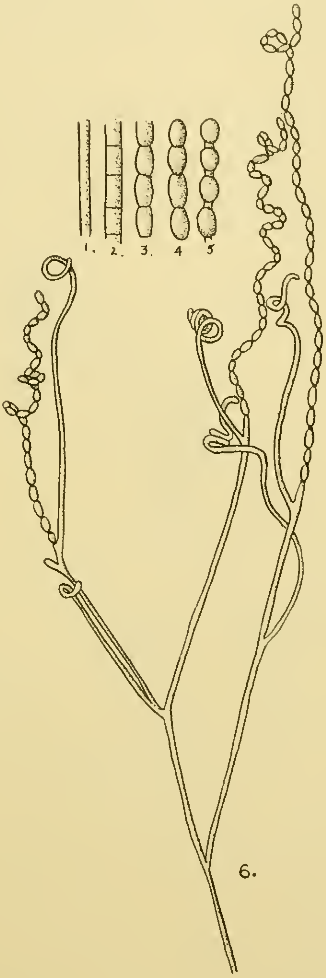

Fig. 116.—*Actinomyces aureus*. *1-5*, stages in the development of a sporogenous hypha: *6*, erect fructifications terminating long, prostrate aerial hyphae, exhibiting a pronounced tendency toward the successive type of development and showing cuneate hyphal enlargements below the insertions of branches (×2,750). (After Drechsler 1919.)

spores are thus connected by hyaline isthmuses. Occasionally an isthmus may be found with a remnant of the old deeply staining septum still unchanged in its center.

Besides these three, there is another group in which the septa are not to be demonstrated by the ordinary stains. The protoplast appears to contract at regular intervals, yielding a series of noncontiguous spores, held together for a time by the connecting segments of the evacuated hyphal wall (Fig. 117). Drechsler believed that cross walls appear in the development of sporogenous hyphae throughout the genus but are too thin to be seen in these forms.

Owing to the very small size of the cells, it is not always possible to distinguish nuclei from metachromatic granules. The spores germinate in dilute nutrient solutions by swelling and emitting 1-4 germ tubes, the number being quite characteristic for each species.

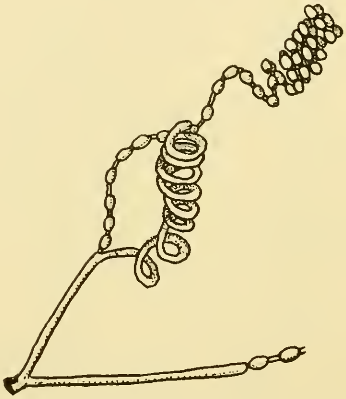

Fig. 117.—*Actinomyces Lavendulae.* Portion of aerial hypha (×2,750). (After Drechsler 1919.)

Methods for Study.—Drechsler recommends the following methods as being especially suitable for studying *Actinomyces.* The fungus is grown on a suitable substratum, such as potato or glucose agar. Growth on potato agar is more prompt and productive of mycelium on most species; but as its use, especially with species exerting a strong tyrosinase reaction, stimulates to excessive guttation and disruption of the sporophores by the extruded droplets, a medium not possessing this property is advantageous. After the cultures have attained the proper degree of maturity, the whole growth is cut from the agar and removed from the tube as carefully as possible. A slide, smeared with albumin fixative, is now brought into firm contact with the mycelium and then separated, precautions being taken to avoid any sliding of the two surfaces on each other. If the growth is not too young, this procedure will leave the upper portions of the aerial mycelium adhering to the slide without serious disarrangement, and killing and fixation may be at once effected by the use of strong alcohol. The material is subsequently stained and mounted in balsam. The quality of preparations in which the spore chains have begun to disintegrate in large numbers is impaired by the presence of large masses of free spores which retain their staining properties for some time after maturing. Later the spore walls seem to become entirely impervious to stains and, as a result, when the secondary mycelium develops, no difficulty is encountered from this source beyond a slight clouding effect. The best results are obtained when the print is made soon after the mycelium begins to adhere readily to the smeared slide. The nature of the killing agent employed was found to have no noticeable effect on the preparation. Flemming's weak and strong, picroformal, picro-acetic, Carnoy, and 95% alcohol were tried. To save time in washing, alcohol is most frequently employed. Delafield's hematoxylin, which is the most satisfactory stain, is allowed to act 24 hours and then the preparation is decolorized. Vacuoles, metachromatic and nuclear structures, as well as septa, show clearly.

Potron & Thiry (1913) recommend the following toluidine blue stains in pus from a case of actinomycosis. The smear is dried, fixed in the flame, cooled. A small amount of the powdered dye is placed on the smear and a drop of water added. After the stain has acted a short time it is rinsed off, and the preparation is dried and mounted in balsam, or the toluidine blue may be rinsed with a solution of 1% eosin in 90% alcohol to partially decolorize, then rinsed in water, dried, and mounted. Or the slide may be left in Lugol's solution a few minutes before decolorizing with alcoholic eosin. Still another variation consists of partial decoloration with aqueous orange *"de Gole."*

This order is composed principally of saprophytes living in soil, more rarely of facultative parasites of plants, e.g., *A. scabies* on the tubers of the potato (Fig. 118), or parasites on man, where a few species are fairly common and well known, and many have been briefly described with little regard for their morphology and little data regarding their physiology which would enable them to be recognized when they are again encountered.

The physiology of this group has been extensively studied for the saprophytic species by Lieske (1921), and especially the soil organisms by Waksman and coworkers during the last decade.

The systematic position of *Actinomyces* has long been subject to debate, many of those working with pathogenic species placing them among the pleomorphic bacteria, some, e.g., Lieske (1921), Ørskov (1923), and Jensen (1932), placing them in a separate group intermediate between bacteria and fungi; and mycologists, such as Saccardo, Thaxter, and Drechsler (1919) placing them in the Hyphomycetes. In this connection, it is interesting to note that Lieske states that they are very closely related to *Geotrichum candidum* (*Oidium lactis*), an undoubted member of the Hyphomycetes. Claypole (1913) regarded them as an ancestral type of microörganism, giving rise to yeasts and higher filamentous fungi and to mycobacteria, corynebacteria, and the other bacteria.

While most authors have kept the majority of the organisms of this group in a single genus, various attempts have been made to erect more or less natural groups of species. Wright (1905) would reserve *Actinomyces* for anaerobic organisms, placing the aerobic forms in *Nocardia.* This separation has been widely adopted with varying nomenclature, but is often difficult to apply in practice. I have used this character in my key, although I have kept all the species in *Actinomyces.* Chalmers & Christopherson (1916), followed by Castellani & Chalmers (1919) and Froilano de Mello and coworkers (1918, 1919) have divided the genus into saprophytic and parasitic species. While this might be useful, if only the obligate parasites are included in the parasitic

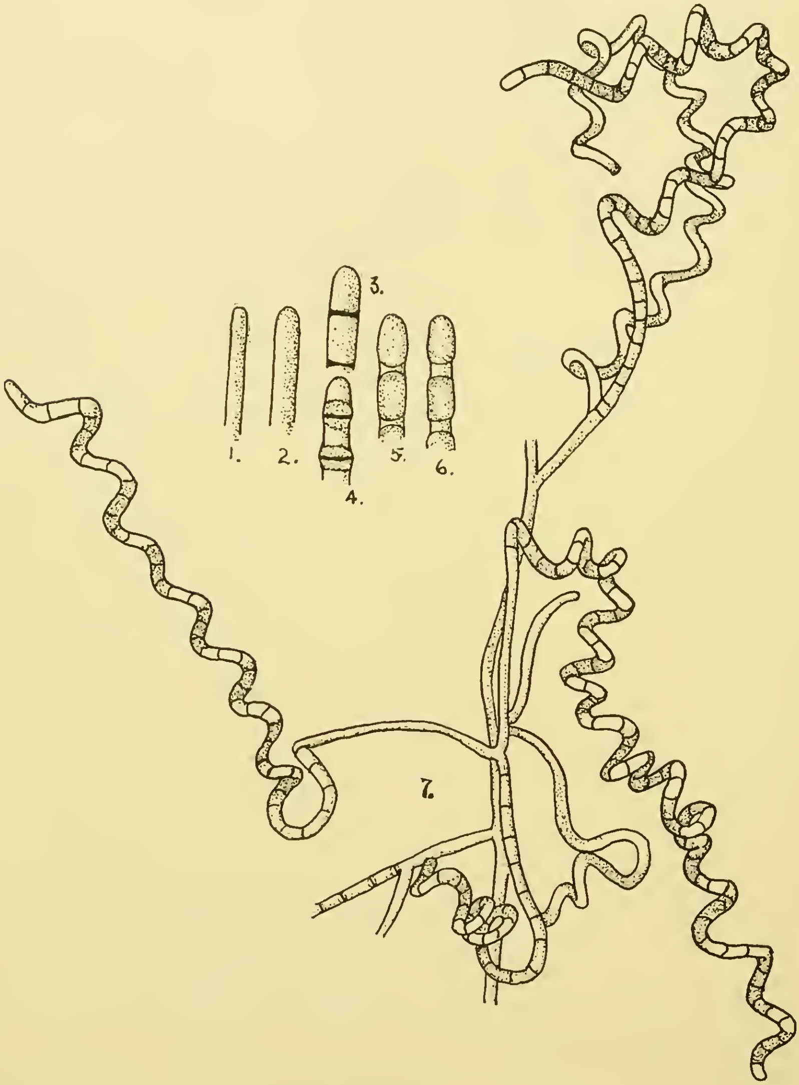

Fig. 118.—*Actinomyces scabies* (Thaxter) Güssow. *1-6,* successive stages in the development of sporogenous branch; 7, portion of aerial mycelium, some lateral elements bearing secondary branches developed successively, with an unusually long chain of spores (*1-6* ×8,000; *7* ×2,750). (After Drechsler 1919.)

groups, it seems extremely artificial as they use it. Their next subdivisions, which are based on comparative physiology and staining reactions, are more natural and have been followed in my key.

Lieske (1921) provided much information but did not attempt any classification. Ørskov (1923) proposed to redefine *Cohnistreptothrix* to include organisms which form a unicellular, nonseptate vegetative mycelium, and an aerial mycelium composed of hyphae, thicker than those of the vegetative mycelium and divided into spores of uniform size and shape. He retained *Actinomyces* for organisms in which the vegetative as well as the aerial mycelium divide by septa into pieces of irregular size and shape without any spores, as in his *Cohnistreptothrix.* He created a new genus, *Micromonospora,* for organisms which form a unicellular mycelium without aerial hyphae but with spores borne singly on the tips of short branches of the vegetative hyphae. This classification by Ørskov is a step in the right direction, but it is obviously impossible to apply it to the pathogenic species in the present state of our knowledge, almost none of which have been described morphologically with sufficient care to place them. I suspect that when the morphology has been carefully studied, the *Majores* of Chalmers & Christopherson will be found to belong in *Cohnistreptothrix* of Ørskov not of others, their *Minores* in his *Actinomyces,* and their *Breves* in his *Micromonospora* with a certain amount of redefinition and readjustment. Jensen accepts Ørskov's classification for his soil organisms, adding to the nomenclatural confusion by replacing *Cohnistreptothrix* Ørskov by *Actinomyces,* and *Actinomyces* Ørskov by *Proactinomyces.* He includes *Corynebacterium, Mycobacterium,* and his *Proactinomyces* in his Proactinomycetaceae, leaving *Actinomyces* and *Micromonospora* for his Actinomycetaceae.

While is it quite possible that *Corynebacterium* and *Mycobacterium* may sometime be shown to belong to this group, the literature on these genera is so extensive and well known to the medical man that no attempt will be made to cover it in this work.

Since so little morphologic work has been done on this group, it seems wiser to leave all the species in *Actinomyces* than to attempt a separation. *Cohnistreptothrix* has been used for the anaerobic species, but in the present chaotic state of the literature it is difficult to separate strict anaerobes from partial anaerobes. *Actinobacillus* is recognized by Buchanan, Bergey, and others as a distinct genus. Its morphology needs further study before its systematic position will be clear. *Malbranchea* was proposed many years ago and recently revived by Vuillemin. It is not distinguishable from many species of *Actinomyces,* in fact it shows the characteristic morphology of that genus.

ACTINOMYCES

Actinomyces Harz, Jahresber. Münchener Central-Thierarzneischule **1877**: 125-140, 1877.

Streptothrix Cohn, Beitr. Biol. Pflanzen **2**: 186, 1875, non Corda, Prachtflora Europ. Schimmelbildungen 27, 1839.

Cladothrix Cohn, Beitr. Biol. Pflanzen **2**: 185, 1875, non DeCandolle 1849.

Discomyces Rivolta, Clin. Vet. Milano **1**: 208, 1878.

Malbranchea, Saccardo & Penzig, Michelia **2**: 639, 1882.

Nocardia Trevisan, I genera e le specie delle Batteriacee. 9, 1889.

Micromyces Gruber, Centralbl. Bakt. **10**: 648, 1891, not Dangeard, 1888.

Oospora Sauvageau & Radais, Ann. Inst. Pasteur **6**: 242-273, 1892, non Wallroth, 1833.

Cohnistreptothrix Pinoy, Bull. Inst. Pasteur **11**: 929, 1913.

The type species is *Actinomyces bovis* Harz.

Mycelium usually branched, very slender, usually less than 1μ in diameter, seldom more than 1.5μ, probably septate, but the septa are often very difficult to observe; conidia are borne on specialized conidiophores, usually in coiled chains which are very fragile and break up so easily that they are difficult to observe. Primarily soil saprophytes; a few species are parasitic on animals, and still fewer on plants.

Key to Species

- Cultures unknown.
  - Seen in juxta-articular nodules. *A. Carougeaui.*
  - Seen in calcareous deposits in muscles of swine. *A. musculorum.*
- Cultivated.
  - Obligate anaerobes.
    - Bacillary forms only seen in cultures.
      - Growth on gelatin which is liquefied; from dacryocystitis. *A. Silberschmidti.*
      - Culture difficult, no liquefaction of gelatin; ulcers on muzzles of rabbits. *A. cuniculi.*
    - Hyphae seen in cultures.
      - No growth on gelatin or potato, but good on ascitic agar.
        - Isolated from pus. *A. Neschczadimenki.*
        - Isolated from axillary and pubic hair. *A. tenuis.*
      - Good growth on gelatin.
        - Gelatin liquefied; isolated from blood in generalized infection. *A. Thjoettae.*
        - Gelatin not liquefied; calf diphtheria. *A. necrophorus.*
  - Facultative aerobes, growth better under partial anaerobic conditions.
    - Growth on usual media, clavate bodies present.
      - Not pathogenic for laboratory animals, from concretions in lacrimal canal, colonies grayish.
        - Growth on potato, starch digested. *A. Foersteri.*
        - No growth on potato, starch not digested. *A. discofoliatus.*
      - Pathogenic for laboratory animals.
        - Colony yellowish; human actinomycosis. *A. Israeli.*
        - Colony white; subcutaneous and intramuscular nodules. *A. Thibiergei.*
    - Growth absent on usual media, gram-negative.
      - Colony translucent on ascitic agar; isolated from pubic and axillary hair. *A. tenuis.*

Colony opaque.

Not pathogenic for laboratory animals; isolated from calves with pneumonia. *A. actinoides.*

Pathogenic for guinea pig; isolated from liver abscesses and pulmonary infection. *A. americanus.*

Pathogenicity not stated; isolated from mycetoma of the outer ear. *A. cylindraceus.*

Aerobic, at least growth much better under these conditions.

Gelatin liquefied, often serum also, not acid-fast, good growth on potato, diastase often present, odor earthy or moldy, efflorescence spreading, bright, chalky, growth good at 22° and 37° C., branching abundant in mycelium.

Serum not digested or action on serum unknown.

Colonies deep green; from soil, pathogenic for experimental animals. *A. viridis.*

Colonies deep red with white margin on potato, white on agar; from dermatosis. *A. panginensis.*

Colonies red on agar and potato; isolated from sputum, not pathogenic for experimental animals. *A. mineaceus.*

Colonies yellow to brown.

No pellicle on broth; from corneal infection. *A. cerebriformis.*

Pellicle often fragile on broth.

Growth on potato; tumors in domestic fowl. *A. tossicus.*

No growth on potato; from lesions on sheep, producing lumpy wool. *A. dermatonomus.*

Colonies white on most media.

Milk not coagulated.

On milk, growth slow, digestion in three weeks; from mycetoma pedis. *A. mexicanus.*

On milk, forming a flesh-colored, folded pellicle with white efflorescence, only fat assimilated; from bronchopulmonary infection. *A. Rivierei.*

Milk coagulated.

Growth on milk not stated, but no pellicle on other liquid media; from enlarged spleen. *A. Gibsoni.*

No pellicle on liquid media, colony white becoming café-au-lait on potato; from black tongue. *A. Guegueni.*

Pellicle on vegetable decoction only; colony chestnut color on potato; from erythrasma. *A. Pinoyi.*

Pellicle on most liquid media (saprophytes).

Colony white on potato, medium colored yellowish or brownish. *A. goensis.*

Colony yellowish waxy on potato, medium not colored. *A. Christophersoni.*

Pellicle on milk folded, dark green; from air, pathogenic for experimental animals. *A. pyogenes.*

Pellicle on milk yellowish.

From sputum. *A. gypsoides.*

From water and laboratory contamination. *A. invulnerabilis.*

Serum digested.

Colony white or grayish on most media.

Colony rose, cerebriform on glycerol agar. *A. roseus.*

Colony white, from sputum. *A. candidus.*

Colony white, with an amber yellow margin, medium discolored; from pseudotuberculosis. *A. albus.*

Colony grayish, medium discolored; from abscesses. *A. Garteni.*

Colony white becoming greenish on old cultures.

From mycetoma. *A. Nicollei.*

From conjunctivitis. *A. Dassonvillei.*

Colony grayish, medium not discolored; secondary invader of ringworm lesions. *A. minimus.*

Colony grayish, star-shaped or cruciform; from infection of cornea. *A. radiatus.*

Colony yellowish to brownish on most media.

Pellicle on liquid media, milk coagulated.

Colonies grayish violaceous with reddish brown margin; from angina. *A. rubidaureus.*

Colonies white, later brownish; from mycetoma. *A. Avadi.*

No pellicle on liquid media.

No growth on potato; from pus. *A. Levyi.*

On potato, gray to canary yellow; medium darkened; lumpy jaw. *A. bovis.*

On potato, straw yellow, medium not darkened, grows with difficulty; from mycetoma. *A. liquefaciens.*

On potato, yellow, thick, verrucose; from conjunctivitis. *A. aureus.*

On potato, café-au-lait with no pigmentation of medium; from conjunctivitis. *A. luteolus.*

Gelatin usually not liquefied; serum not liquefied, usually acid-fast, good growth on potato, but no diastatic action, odorless or nearly so; efflorescence circumscribed, dull, powdery, growth good at 37°, fair at 22° C.; hyphal branching poorly marked.

No growth on potato, or growth very poor.

Growth on gelatin.

Colony white on gelatin. *A. gedanensis.*

Colony grayish on gelatin; cacao brown on carrot; from sputum. *A. catarrhalis.*

No growth on gelatin; from roots of decaying teeth.

Sediment in broth yellowish, not acid-fast. *A. Matruchoti.*

Sediment in broth white. *A. Rodellae.*

Growth good on potato.

Colonies white, pellicle on broth.

Action on gelatin unknown, milk digested; from saliva of horse. *A. Chalmersi.*

Gelatin slowly liquefied; mycetoma pedis. *A. Tarozzii.*

Gelatin not liquefied; mycetoma. *A. Ribeyroi.*

Colonies pink or reddish, not yellowish or brownish.

Pellicle on broth or other liquid media.

Dissolving the horny layer of the skin in grooves (keratoderma plantare sulcatum). *A. keratolyticus.*

Pathogenicity uncertain, salmon pellicle on milk; from blood of horse. *A. pluricromogenus.*

    - Producing mycetoma pedis.
      - No growth on milk; color brick red. *A. micetomae.*
      - Milk not coagulated; salmon color. *A. verrucosus.*
      - Milk slowly peptonized after twenty days.
        - Acid-fast. *A. Sommeri.*
        - Not acid-fast. *A. Madurae.*
      - Growth on milk not reported, colonies deep red. *A. bahiensis.*
  - No pellicle but some floating colonies which sink before forming pellicle; from lungs.
    - Colonies coral pink. *A. Leishmani.*
    - Colonies flesh or orange red. *A. carneus.*
  - Growth on liquid media unknown.
    - Colonies wine red; from erythrasma. *A. minutissimus.*
    - Colonies white with salmon mammillae; from case resembling bubonic plague. *A. Jollyi.*
    - Colonies with yellow center and pink periphery; from mycetoma pedis. *A. Freeri.*
- Colonies yellow to brown on most media, rarely also reddish on some one or two media.
  - No pellicle on liquid media.
    - No growth on gelatin; from sample of vaccine, pathogenic for experimental animals. *A. Hofmanni.*
    - Growth on gelatin.
      - Substrate blackened on sugar media; from air. *A. niger.*
      - Substrate not blackened.
        - Gelatin very slowly liquefied.
          - Growth slow on potato; from mouth. *A. lingualis.*
          - Growth good on potato; from granuloma. *A. phenotolerans*
          - Growth good on potato; from cereal dust. *A. Bellisari.*
        - Gelatin not liquefied.
          - Serum liquefied; mycetoma. *A. convolutus.*
          - Serum not liquefied.
            - Broth colonies not described; actinomycosis of bones. *A. serratus.*
            - Gas produced on broth; pulmonary infection. *A. Donnae.*
            - No gas on broth; colony on potato reddish; corneal ulcers. *A. deBerardinis.*
  - Floating colonies which are not confluent.
    - Gelatin slowly liquefied; cattle farcy. *A. farcinicus.*
    - Growth poor in gelatin; lungs. *A. japonicus.*
  - Pellicle on surface of liquid media.
    - Milk coagulated; mycetoma. *A. pretorianus.*
    - Milk digested without coagulation; lumpy jaw of marsupials. *A. macrodipodidarum.*

Milk not coagulated or digested.
Pellicle pink in milk.
On dog. *A. canis.*
On goat. *A. caprae.*
Pellicle on milk yellowish.
On potato, colony white, granular; brain and bronchial abscesses. *A. bicolor.*
On potato, colony orange yellow; mycetoma. *A. brasiliensis.*
On potato, colony yellowish red or brick color.
Pellicle on broth waxy and fragile; from pseudotuberculosis with cerebrospinal meningitis. *A. asteroides.*
Pellicle on broth thick yellowish; from rat. *A. Sanfelicei.*

Often slight indications of liquefaction of gelatin and serum, rarely acid-fast, growth difficult on most media at 37° C., none at 22°; little or no growth on potato, no diastatic action, odor sometimes feculent, slight or no efflorescence, hyphal branching rare.
Growth on gelatin.
Red pigment diffusing into gelatin; from sputum. *A. spumalis.*
No red pigment diffusing into gelatin.
Colony yellowish. *A. flavus.*
Colony white; lumpy jaw. *A. Spitzi.*
No growth on gelatin.
No growth on agar, sometimes on blood agars and similar media.
Growth on potato white with brown efflorescence; bronchopneumonia. *A. cruoris.*
No growth on potato.
Colonies red or orange; mycetoma pedis. *A. africanus.*
Colonies not red.
No growth on carrot, growth on serum. *A. Berestneffi.* *A. Ponceti*
Growth on carrot, probably none on serum; from stomatitis. *A. buccalis.*
Growth on agar.
Colonies yellowish.
No growth on potato; from abscess on jaw. *A. Krausei.*
Little growth on potato, not acid-fast; from sputum in bronchitis. *A. Pijperi.*
Good growth on potato, acid-fast; pseudotuberculosis. *A. Sartoryi.*
Colonies white.
Pellicle on liquid media.
Growth on potato; mycetoma pedis. *A. transvalensis.*
No growth on potato.
Red brown pigment diffusing into medium; from sputum. *A. fuscus.*
Pigment not diffusing into medium, endocarditis of cattle. *A. valvulae.*

No pellicle on liquid media.
  Slight fermentation of sugars; bronchomycosis. *A. bronchialis.*
  No fermentation of sugars; pulmonary infection. *A. pulmonalis.*
  No fermentation of sugars; nodules on jaw of horse. *A. equi.*
Growth on gelatin not reported.
  Gram-negative; from blood, fever following animal bites.
    No growth on common media, slight growth in broth to which patient's blood was added. *A. Taraxeri-cepapi.*
    Growth on blood agar and blood serum. *A. Putorii.*
      A. muris-ratti.
  Gram-positive or staining not given; growth on agar without addition of blood.
    From abscesses.
      Clavate formations in broth; from tongue abscesses, pathogenic for rabbits. *A. londinensis.*
      Clavate formations in broth; from chest abscesses and sputum, not pathogenic to rabbits. *A. Foulertoni.*
    From whitish dry scaly lesions. *A. decussatus.*

Actinomyces Carougeaui (Gougerot) Brumpt, Précis. Parasitol, ed. 4, 1206, 1929.

Discomyces Carougei Gougerot, C. R. Soc. Biol. **67**: 580, 1909.

Nocardia Carougeaui Castellani & Chalmers, Man. Trop. Med. ed. 2, 817, 1913.

Streptothrix Carougeaui Greco, Origine des Tumeurs, 724, 1916.

Cohnistreptothrix Carougeaui Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 273, 1916.

The lesion caused by this organism was referred to as a paramycetoma by Chalmers & Archibald, N. Orleans Med. Surg. Jour. **70**: 466, 1918. The authors have been unable to cultivate the organism. It was named from mycelium seen in the tissues described as "nodosités juxta articulaires."

Actinomyces musculorum Hertwig, Arch. Wiss. Prakt. Tierheilk. **12**: 365-372, *Pl. 6,* 1886.

Oospora musculorum suis Lehmann & Neumann, Atlas Grundriss Bakt. 376, 1896.

Not cultivated but seen in calcareous deposits in the muscles of swine.

Actinomyces Silberschmidti (Chalmers & Christopherson) Dodge, n. comb.

Cohnistreptothrix Silberschmidti Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 273, 1916.

Streptothrix sp. Silberschmidt, Centralbl. Bakt. **27**: 286-493, 1900; Zeitsch. Hyg. **37**: 345-380, *Pls. 3, 4,* 1901.

Nocardia Silberschmidti Froilano de Mello & Fernandes, Mem. Asiatic Soc. Bengal. **7**: 111, 1919.

Isolated from cases of dacryocystitis. Not greatly pathogenic to rabbit.

This organism is a strict aerobe.

Colonies on agar deep, round, pinhead size, giving a grayish white uneven surface to the culture. No growth on potato or serum. In broth there is a deposit, yellowish or grayish white, in the bottom. Gelatin not liquefied.

Actinomyces cuniculi (Schmorl) Gasperini, Centralbl. Bakt. I, **15**: 684, 1894.

Streptothrix cuniculi Schmorl, Deutsche Zeitsch. Thiermed. Vergleich. Path. **17**: 375-408, *Pls. 7, 8,* 1891.

Streptothrix necrophora Kitt, Bakterienkunde 1900.

Cladothrix cuniculi Macé, Traité Bact. ed. 6, **2**: 753, 1913.

Cohnistreptothrix cuniculi Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 273, 1916.

Nocardia cuniculi Froilano de Mello & Fernandes, Mem. Asiatic Soc. Bengal. **7**: 107, 1919.

Oospora cuniculi Sartory, Champ. Paras., 824, 1923.

Isolated from ulcers in the muzzles of rabbits. They spread to other organs and are, eventually, fatal. Pathogenic to rabbit and mouse; not to guinea pig, dog, cat, hen, or pigeon.

Hyphae 0.75-1.5μ in diameter and are up to 100μ long. The organism is gram-positive and a strict anaerobe; optimum temperature 37°, no growth below 30° or above 40° C.

On serum agar, only deep colonies appear. They are dull white, spherical, very small. No development on potato. On serum, small, grayish white, finely radiate, deep colonies. No growth in upper centimeter. In broth, there is a slight development with uniform turbidity. Neither coagulated serum nor gelatin liquefied.

Schmorl's organism is reported by Sanfelice to be a *Corynebacterium.*

Actinomyces Neschczadimenki (Chalmers & Christopherson) Dodge, n. comb.

Cohnistreptothrix Neschczadimenki Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 223-282, 1916.

Streptothrix sp. Neschczadimenko, Centralbl. Bakt. I, **44**: 573-578, *1 pl.,* 1908.

Oospora sp. Sartory, Champ. Paras. Homme Anim., 827, 1923.

Found in the pus from a lesion near the navel. An account of pathogenicity promised for a later paper.

Hyphae 0.75-1.00μ in diameter, some irregular ones attaining 1.5μ. Strict anaerobe, gram-positive, optimum temperature 37° C.

On agar, colonies whitish gray, becoming darker, then yellowish, especially in the center. No growth on gelatin or potato. On coagulated serum, growth is similar to that on agar, with no pigmentation of the medium. In broth, containing egg yolk, there appear whitish granules on the walls and at the bottom, the medium remaining clear. Granules measure 0.5 × 4.5-9μ, sometimes 1 × 18-20μ in the swollen portions.

Actinomyces Thjoettae Dodge, n. sp.

Cohnistreptothrix sp. Thjøtta & Gundersen, Jour. Bact. **10**: 1-12, *9 figs.*, 1925.

Found in a case of generalized infection with acute rheumatism, pleuritis, pericarditis, and bronchitis. Thought by authors to be a saprophyte close to that of Löhlein. Nonpathogenic to laboratory animals.

On veal broth medium, colonies as described below, hyphae nonseptate, showing no clubs and no spores in bottom growth. In surface growth hyphae slender or thick, twisted, breaking up into ovoid spores. Generally gram-positive.

On lactose agar, growth rapid, producing smooth, shining, circular, efflorescent adherent colonies after a few days. Surface growth on agar gram-positive, coccoid forms occasionally gram-negative. Hyphae observed. When 10 c.c. of the patient's blood is added to veal broth to which has also been added 0.2 gm. secondary sodium phosphate instead of NaCl, with a pH 7.8, and this incubated at 37° C. for two weeks, there is a growth of small, woolly colonies on layer of blood at the bottom; surface colonies dry and scaly with the medium clear. In broth, the optimum pH is 7.4. Coagulated ox serum not liquefied. Gelatin rapidly liquefied.

Actinomyces necrophorus (Flügge) Lehmann & Neumann, Bakt. Diag. ed. 2, **2.**

Bacillus necrophorus Flügge, Die Mikroorganismen 265, 1886.

Streptothrix necrophora Ernst, Monatsh. Prakt. Tierheilk. **14**: 193-228, 1902.

Isolated from calf diphtheria.

Hyphae 100μ long, gram-positive, anaerobic.

In gelatin and agar, fine, white to yellow spherical colonies, center opaque, margin showing filaments, no surface growth. In coagulated horse or ox serum, colonies reddish or brownish red. In milk, odor of stinking cheese. No growth in broth, etc. Pathogenic to experimental animals.

Actinomyces Foersteri (Cohn) Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Streptothrix Foersteri Cohn, Beitr. Biol. Pflanzen **1**: 186, 1874, non Gasperini, 1890.

Cladothrix Foersteri Winter, in Rabenhorst Kryptogfl. Deutschl. ed. 2, **1**: 60, 1884.

Cladothrix dichotoma Macé, Traité Pratique Bact., 1888.

Nocardia Försteri Trevisan, in Sacc. Syll. Fung. **8**: 928, 1889.

Oospora Försteri Sauvageau & Radais, Ann. Inst. Pasteur **6**: 242-273, 1892.

Discomyces Foersteri Gedoelst, Champ. Paras. Homme 176, 177, 1902.

Isolated from concretions in the lacrimal canal. A facultative anaerobe, not pathogenic for laboratory animals.

Hyphae straight, curved, or in irregular helices, 0.5-0.6μ in diameter, arthrospores ovoid, 0.8μ in diameter.

On agar, small round colonies, confluent in a mammillate pellicle, folded, grayish, covered with whitish efflorescence. On potato, growth is rapid, chalky; starch is hydrolyzed to sugar. On gelatin, white spheres with short radiating hyphae at the periphery. In broth, there forms a sediment of small grayish spheres at the bottom, mouldy odor.

Actinomyces discofoliatus Gruter, Zeitschr. Augenheilk. **79**: 477-510, *13 figs.,* 1933.

Isolated from concretions in the tear ducts, not very pathogenic for experimental animals.

Mycelium branching, gram-positive in concretions; in cultures spores in chains of 3-10 cells borne on tips of short branches, terminal spores somewhat larger; spores gram-negative at maturity.

On agar, colonies grayish white, round, moist, 3-5 mm. in diameter, adherent to the substrate, no pigment formed. In anaerobic cultures, growth slower but good, yellowish white colonies, 5-8 mm. in diameter. In agar shake, growth similar, with leaflike outgrowths that become imbricate (like shingles on a roof). On gelatin, growth good along the stab. On Loeffler serum, colony thin, slightly granular. No growth on potato. On broth, abundant gray white sediment leaving liquid clear. Growth at both 22° and 37° C. No hemolysis, no digestion of starch, no coagulation of milk, and no liquefaction of gelatin.

Actinomyces Israeli (Kruse) Dodge, n. comb.

Streptothrix Israeli Kruse in Flügge, Mikroorganismen 56, 1896.

Discomyces Israeli Gedoelst, Champ. Paras. Homme 163-167, 1902.

Discomyces bovis Brumpt, Arch. de Parasitol. **10**: 489-572, 1906 non al.

Nocardia Israeli Castellani & Chalmers, Man. Trop. Med. ed. 2, 814, 1913.

Cohnistreptothrix Israeli Pinoy, Bull. Inst. Pasteur **11**: 932, 1913.

Brevistreptothrix Israeli Lignières, Ann. Parasitol. Hum. Comp. **2**: 19-22, 1924.

Found in a case of human actinomycosis. Wolff-Israel, Arch. Path. Anat. Physiol. [Virchow] **126**: 11-59, *Pls. 1-8,* 1891.

Mycelium bacillary, grows best anaerobically. Coccoid forms in old cultures. Serum-agar colonies resemble drops of dew, finally becoming yellowish. In broth, there appears a deposit in the bottom of the tube. No growth on gelatin.

Fungi of Doyen 1891, Jurinka 1896, Silberschmidt 1901, Schukevich 1902, Doepke 1903, and Wright 1904 were referred here by Froilano de Mello.

Actinomyces Thibiergei (Ravaut & Pinoy) Greco, Origine des Tumeurs . . . . 723, 1916.

Discomyces Thibiergei Ravaut & Pinoy, Ann. Derm. Syphiligr. IV, **10**: 417-432, *Pls. 2, 3,* 1909.

Nocardia Thibiergei Castellani & Chalmers, Man. Trop. Med. ed. 2, 817, 1913.

Cohnistreptothrix Thibiergei Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 273, 1916.

Oospora Thibiergi Sartory, Champ. Paras. Homme Anim. 792, 1923.

Isolated from subcutaneous and intramuscular nodules showing very small white grains in the pus. Medicated with KI. Nonpathogenic to laboratory animals.

Hyphae 0.2μ in diameter, branched, producing bacillary arthrospores, 2 × 0.2μ, curved. Sclerotia 80μ in diameter, claviform formations present. Organism is gram-positive and aero-anaerobe. Aerobic cultures give the more filamentous forms. Optimum temperature 37°-38° C.

On ordinary agar, colonies elevated, rugose, rooting, adherent. On maltose agar, small white colonies. On potato-glycerol, small, white, translucent granules form. In broth, bottom growth shows white grains. Growth is best when broth is enriched with egg albumen or serum.

Perhaps the following unnamed species of van Loghem should be referred here:

Streptothrix sp. van Loghem, Centralbl. Bakt. I, **40**: 298-305, 1906.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 828, 1923.

Isolated from the pus of the abscesses in a fatal generalized infection, also from the sputum. Pathogenic to guinea pig and rabbit.

Hyphae up to 40μ long, branched. Spores 4 × 0.5μ. Ends of the hyphae thickened. Organism is both aerobic and anaerobic, optimum temperature being 37° C., no growth at 22° C.; gram-positive.

In agar, colonies white, adherent, round. Anaerobic growth on glucose agar shows slight, amber, irregular, convoluted colonies, 3-4 mm. in diameter. No fermentation. In broth, there is a sediment of white masses up to 5 mm. in diameter, no pellicle, and medium remains clear. No growth on serum, milk, or potato.

Actinomyces tenuis (Castellani) Dodge, n. comb.

Nocardia tenuis Castellani, Brit. Jour. Derm. Syphilis **23**: 341, 1911.

Discomyces tenuis Castellani, Proc. Roy. Soc. Méd. **6**: Derm. 23-27, 1912.

Cohnistreptothrix tenuis Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from cases of trichomycosis axillaris, flava, rubra, and nigra. This species really causes only trichomycosis flava. The other colors are developed by bacteria living with the fungus.

Bacillary bodies 4-10 × 1-1.5μ, straight or bent, variously branching. Gram-positive, not acid-fast (not cultivated in 1912)

Macfie, Ann. Trop. Med. Parasitol. **10**: 283-289, 1916, claims to have cultivated this species on ascitic agar. Colonies translucent, colorless, with a slightly opaque center; on transplants, hyphae 0.6μ in diameter. Gram-negative, not acid-fast. On old colonies, hyphae gram-positive; bacillary and cocciform bodies found. On parasitized hairs, gram-negative at first, but gram-positive on old infections.

Actinomyces americanus (Chalmers & Christopherson) Dodge, n. comb.

Streptothrix sp. Bloomfield & Bayne-Jones, Johns Hopkins Hosp. Bull. **26**: 230-233, 1915.

Cohnistreptothrix americana Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 273, 1916.

Isolated from a liver abscess, also from a chronic, low grade pulmonary infection. No granules in the pus. Organism shows low pathogenicity for guinea pigs, no general infection but local chronic infections which tend to heal spontaneously.

Organism grows best under a partial oxygen pressure, 1-2 cm. below the surface. No growth at room temperature, optimum temperature 37° C. No clavate forms. Hyphae 0.5μ in diameter. Gram-positive, not acid-fast.

Small gray colonies appear on ascitic glucose agar, 1 mm. in diameter, opaque with a dark center and irregular edges. No growth on usual media.

Actinomyces actinoides (T. Smith) Bergey, Man. Det. Bacteriol. 346, 347, 1923.

Bacillus actinoides T. Smith, Jour. Exp. Med. **28**: 333-344, *Pls. 25-28,* 1918.

Isolated during a mild epidemic of pneumonia in calves over four weeks old. Not pathogenic for laboratory animals.

Mycelium and spherical spores reported; clavate forms in lungs of calves. Gram-negative. Optimum temperature 37° C. Organism a partial anaerobe.

On agar, colonies minute, pale, straw-colored, with flocculent growth in water of condensation. In blood serum, there is flocculent growth in the water of condensation, nitrates not reduced. No growth in gelatin, broth, milk, or potato.

Actinomyces cylindraceus (Korte) Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

Nocardia cylindracea Korte, Ann. Trop. Med. Parasitol. **11**: 205-278, *Pls. 8, 9,* 1918.

Discomyces cylindraceus Neveu-Lemaire, Précis. Parasitol. Hum. 44, 1921.

Oospora cylindracea Sartory, Champ. Paras. Homme Anim. 774, 775, 1923.

Isolated from an infection of the outer ear, resembling mycetoma and containing grains.

Aero-anaerobic. On glucose agar shakes, cylindric or hollow spherical colonies form in the medium, semitransparent, very adherent hyphal tips sometimes enlarged but no free spores seen. Unable to subculture, acid-fast.

On blood smear agar, to which sterile cerebrospinal fluid has been added, small, pale lemon yellow, adherent colonies after smearing, appear like acid-fast bacilli, 0.3-0.5 × 1-4μ; rods allantoid, mostly curved, stain unevenly. No clavate forms, gram-negative; in subcultures, gram-positive; dots in the gram-negative rods.

Aerobic culture produces oidial form (bacilliform) in sterile ovarian fluid, development with smell of old boot leather or of a tannery, as in patient's ear. Not acid-fast. Grayish, tough, slimy growth. Finally, after 7 months in broth, oidal converted to arthroidal form; colony spheroidal. Mycelium transferred into glucose agar shake yielded surface growth, gram-negative nonacid-fast, bacilliform hyphae and terminal or intercalary chlamydospores.

On glycerol potato, oidial form shows no growth, arthroidal form thin, scanty, yellow, discoloring potato and liquid. On gelatin, no growth. On glucose agar shake, oidial form shows no growth in depth, arthroidal form profuse, dirty yellow, slimy growth. On blood agar, oidial form solid, heaped up, discrete, pale orange, no digestion of hemoglobin. Arthroidal form dirty yellow, slimy, collecting in the water of condensation as oily balls, hemoglobin digested. In litmus milk, fine fawn-colored flocculus in the oidial form, color partly dissipated with slight digestion of curd, arthroidal form showing complete decolorization and more marked digestion. In inspissated sheep serum the oidial form shows slight digestion, forming a clear fluid with a slight scum, while the arthroidal form shows more marked digestion, opalescent fawn-colored fluid with a slight dirty yellow scum.

The following organism belongs in this group, but in the absence of cultural characters, it cannot be placed more definitely.

Actinomyces anaerobies Plaut.

Actinomyces sp. Butterfield, Jour. Infect. Dis. **2**: 421-430, *1 pl.*, 1905.

Oospora anaerobies Sartory, Champ. Paras. Homme Anim. 830-832, 1923

Isolated from the lung of an American male, 19 years old, primarily suffering from diabetes mellitus. Urine showed 3.5% to 8% glucose, also acetone and diacetic acid. Filaments of *Actinomyces* isolated from pus in wall cavity of right lung, also from bronchopneumonic tissue constituting the walls of the cavity. In the latter, the organism was present in the small bronchi, bronchioles, and in the air sacs filled with leucocytes. Best demonstrated by staining with Weigert's modification of Gram's method. No other organisms found

In tissues, organism usually appears as tangled masses of branching hyphae, sometimes in a distinct radiate arrangement with beaded hyphae in the more central portions. No clavate forms observed in examination of hundreds of such colonies. Organism acid-fast.

Actinomyces viridis (Lombardo-Pellegrino) Dodge, n. comb.

Streptothrix viridis Lombardo-Pellegrino, Riforma Med. **19**: 1065-1068 1903.

Isolated from soil, found pathogenic to rabbit, guinea pig, and cat on experimental inoculation.

Hyphae long, slender, flexuous, branched, acid-fast, aerobic or anaerobic

Colonies green, ranging in shade from that of pistachio to dark green or almost black. Pigment diffusing. Good growth on gelatin and agar, convex, adherent, margin finely lacy; colony dirty white at first, later becoming green. In broth, no turbidity or pellicle, although floating colonies form and settle. Milk colored green and coagulated. On potato, colony whitish, medium becoming very dark violet.

Actinomyces panginensis (Froilano de Mello & St. Antonio Fernandes) Dodge, n. comb.

Nocardia panginensis Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 130, 1919.

A saprophyte isolated from a dermatosis.

Cells 40-60 × 0.8-1μ. Gram-positive, not acid-fast.

On agar, colony white, opalescent, dry granular, margins regularly dentate, efflorescence white. On sugar agars, better developed, yellowish. On potato, colony cinnabar red in the center with white margin, becoming brownish yellow and greenish, medium dirty brown. On broth, pellicle white, adherent, folded, turbidity and sediment present; efflorescence white. Milk coagulated and digested, litmus decolorized.

The following organism, incompletely described, perhaps belongs here.

Actinomyces sp. Burnier & Duché, Bull. Soc. Franç. Derm. Syphiligr. **40**: 581, 1933.

Isolated from a case of superficial eczema, dry, scaly, yellowish red on face, scalp, behind ear, and in inguinoscrotal, abdominal, and genital folds.

Strictly aerobic, gelatin liquefied, efflorescence early, white, abundant; odor moldy; slight red pigment on glucose, peptone, or asparagin media.

Actinomyces mineaceus (Kruse) Lachner-Sandoval, Über Strahlenpilze, 66, 1898.

Cladothrix sp. Ruiz Casabó, Cron. Méd. Quirúrg. Habana **20**: 340-343, 1894.

Streptothrix mineacea Kruse in Flügge, Mikroorganismen, 63, 1896.

Streptothrix rubra Petri, N. Giorn. Bot. Ital. n. s. **10**: 591, 1903.

Nocardia rubra Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 265, 1916.

Actinomyces ruber Sartory & Bailly, Mycoses Pulmonaires, 252, 1923. Not *Actinomyces ruber* Krainsky, 1914, nor *Nocardia Krainskii*, Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 268, 1916.

Isolated from sputum. Nonpathogenic to laboratory animals.

Sporulation on the fifth day, spores spherical.

On glycerol agar, colony bright red and superficial. On peptone agar, also bright red, granular, dry, rugose, not adherent. Colonies on potato red, spreading rapidly. In broth and milk, red colonies form at the surface and sink to the bottom. Coconut milk becomes turbid, but remains colorless. Gelatin is liquefied, without pigment formation. White pellicle also formed.

Actinomyces cerebriformis Namysłowski, Bull. Internat. Acad. Sci. Cracovie, Cl. Sci. Math. Nat. **1909**: 418-426, *Pl. 21,* 1910.

Isolated in a case of infection of the cornea.

Hyphae up to 1μ in diameter, spores ellipsoid, formed only on old potato and beet cultures.

Colonies on ordinary agar, either yellowish, pulvinate, cerebriform, confluent or waxy, white, slightly elevated, with concentric growth rings. On glycerol agar, colonies are flat, round, margin wavy, often irregular with definite growth zones, wax white and of a waxy consistency. Colonies on potato, ochre yellow to orange yellow, with a white efflorescence. Colonies often almost spherical, 1 mm. in diameter or 2.5 mm. long and 0.5 cm. high, folded. On beet and carrot, bright dirty yellow, pulvinate, confluent colonies. In broth, colonies small, forming flocculent precipitate, medium remaining clear. In liquid blood serum, a deposit of flakes, 1-2 mm. in diameter. Coagulated serum not liquefied. Gelatin is liquefied, the colonies being smaller than in blood serum. No growth on sugar agar, pear, or bread with glucose solution.

It seems probable that the following unnamed species is the same as, or closely related to, *A. cerebriformis.*

Streptothrix sp. Bernardinis & Donna, Ann. Ig. Sperim. **15**: 489-497, *Pls. 8, 9,* 1905.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 813, 1923.

Isolated from a corneal ulcer caused by getting a piece of straw in the eye. Not very pathogenic to rabbit's eye.

Colonies small, not over 1.5 mm. in diameter, slightly elevated, yellow, with a regular margin. Deep colonies brown, granular, regular. On gelatin, growth is similar but slower. On peptone agar, a yellow orange pigment develops. Broth, with 1% glucose, becomes turbid, with a mass of flakes settling out. Discrete growth on coagulated rabbit serum. Gelatin liquefied, liquefaction beginning in 3-4 days.

Actinomyces tossicus (Rossi) Dodge, n. comb.

Actinomyces albus var. *tossica* Rossi, Ann. Ig. Sperim. **9**: 693-708, 1905.

Oospora alba var. *toxique* Sartory, Champ. Paras. Homme Anim. 829, 830, 1923.

Isolated from tumors in the abdominal cavities of domestic fowl. Pathogenic to guinea pigs, rabbits, and chickens.

On agar, growth dirty white, round, adherent, margin areolate, opaque, granulose, yellow brown, covered with a snow white efflorescence. On potato, growth same as on agar. On gelatin, colonies round and dirty yellow with margin fringed. Broth remains limpid with round colonies adhering to the glass, and a farinose, fragile pellicle. Starch liquefied but sucrose not inverted. Milk coagulated. Gelatin liquefied in one week.

Actinomyces dermatonomus Bull. Australian Jour. Exp. Biol. Med. Sci. **6**: 301-314, *2 pls.,* 1929.

Isolated from lesions on sheep, producing copious exudates, which hold the overlying wool together in hard lumps, making shearing of these areas impossible and rendering much wool unmarketable; usually attacks the younger merino animals. Infection varies from 10% to 25% on some farms in Australia. It is uncertain whether the similar condition, reported by Becker, is due to the same organism. In the early stages, a serofibrinous fluid, with a moderate number of leucocytes, exudes, is absorbed by the overlying wool, and then dries. In the later stages, this exudate is mixed with a relatively large number of squamous epithelial cells from the surface of the skin. Chronic lesions become less exudative and more keratogenous or desquamative. In the early stages, the follicle is not involved (although it may be involved later), allowing the wool to pull away from the skin. The horny layer is diffusely invaded by neutrophile polymorphonuclear leucocytes. There is vesiculation of the epithelium in the more superficial parts of the rete mucosum, the vesicles being early invaded by polymorphs. In the cutis vera, surrounding the follicles, there is a well-developed accumulation of leucocytes and plasma cells, with an occasional polymorph. Sometimes there are areas of edema between the follicles, with some hemorrhagic extravasation. The crusts consist of keratinized epithelial cells and polymorphs bound together in a serofibrinous exudate, along with branching mycelium. Organism pathogenic to rabbits where skin has been injured by pulling out hair but not on uninjured skin. Local abscesses caused on subcutaneous inoculation, lesions in rabbit and guinea pigs being very close to those in sheep. Similarly pathogenic to cow and horse, in the latter very desquamative.

The hyphae are short, easily broken into arthrospores. Mycelium is also present in the horny layer, and more sparsely in and around the edematous portions of the corium. Branching lateral, the branches usually of smaller diameter than the main trunk. Mycelium 0.5-1μ in diameter, conidia 0.5-1.75μ, arthrospores 1.8-4.5μ long, usually 3.6μ, often thickened at one end with a wavy contour. Gram-positive, not acid-fast. Aerobic, growth in agar shake at all depths, but the organism is not a strict anaerobe. Optimum temperature 37°, growth very poor at 22° C.

On peptone agar, growth in 24 hours at 37° even, raised, convex to pulvinate, yellowish, opaque, somewhat glistening, 1 mm. in diameter. After 48 hours colony more irregular, less raised, more tenacious, not spreading. No aerial hyphae. Color better developed at 22°, antimony yellow (Ridgway 16 ′b), medium not colored, colonies flatter, center umbonate with raised lobate or lobulate margins. Deep blood agar plates show clear zone of hemolysis, 3.5μ in diameter, around colonies. No digestion in Loeffler's blood serum, good growth, more tenacious. Gelatin liquefied only at pH 7.6, growth saccate, 1 cm. in 14 days. At 37° C. liquefaction is complete in 9 days. No visible growth on potato. In peptone broth, pellicle appears in 24 hours, no clouding, growth on sides of tube with slight sediment, which becomes more abundant as pellicle falls, becoming mucoid. Litmus milk bleached in 4 days, medium digested in 7-8 days, medium yellow. Bromcresol purple milk digested in

7-8 days with increasingly alkaline reaction, ammonia produced. Glucose and fructose acidified but not fermented in 48 hours, glycerol more slowly. Little acidity with galactose and usual disaccharides, polysaccharides, pentoses, higher alcohols, and glucosides. Urea developed an alkaline reaction. No nitrate reduction. Protease active only in alkaline medium producing ammonia, no action on coagulated blood serum, egg white or fibrin.

Actinomyces mexicanus Boyd & Crutchfield, Amer. Jour. Trop. Med. **1**: 268-282, *Figs. 15-18*, 1921.

Nocardia mexicana Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from mycetoma of the foot. Nonpathogenic to guinea pig.

Hyphae 0.7μ in diameter, tortuous, branching, tips sometimes slightly swollen. Chlamydospores formed in blood agar and Loeffler's blood serum. Organism aerobic, optimum temperature being 37° C. Gram-positive, not acid-fast.

On glycerol agar, growth very slow, colonies small, 1 mm. in diameter, more or less convex, tending to be wrinkled. On blood agar, colonies discrete, irregular, rectangular, 3-4 mm. on a diagonal, margins abruptly elevated 1-2 mm., center umbilicate, efflorescent, with a narrow zone of hemolysis. On Conn's synthetic citrate agar (citric acid 5 gm., NH_4Cl 0.5 gm., K_2HPO_4 0.5 gm., glycerol 6 c.c., agar 15 gm., water 1,000 c.c.), colonies small, white, opaque convex, moist. On Waksman's modification of Czapek's agar, no growth visible. On meat infusion agar, colonies discrete, 2 cm. in diameter, with abrupt edges, 1-2 mm. high, center pointed or umbilicate, smooth, moist, slightly yellow. On Krainsky medium (glucose 10 gm., NH_4Cl 0.5 gm., asparagin 1.5 gm., agar 15 gm., water 1,000 c.c.), colonies discrete, circular, not over 2 mm. in diameter, slightly convex, moist and white, mycelium penetrating 2-3 mm. Growth on potato very slow, white and flat, with substrate unaltered. Growth also slow on gelatin. Meat infusion broth shows a flaky sediment, with liquid remaining clear. In carbohydrate peptone water, no fermentation, with colonies appearing as small white balls, not over 1 mm. in diameter, in the bottom of the tube. Medium remains clear. In litmus milk, growth is slow, no coagulation, digested in 3 weeks. Growth also very slow in Loeffler's blood serum as discrete, rectangular colonies 2-3 mm. in diameter, conical, center elevated 1-2 mm., colorless, moist, smooth, no liquefaction in 3 weeks. Gelatin liquefied. Faint fecal odor in cultures.

Actinomyces Rivierei (Verdun) Brumpt, Précis Parasitol. ed. 4, 1201, 1927.

Streptothrix sp. Rivière, Cong. Franç. Méd. Bordeaux 1895, **2**: 1003-1011, 1896.

Actinomyces Sabrazès et Rivieri Berestnev, Diss. Moskva 1897.

Nocardia Rivierei Verdun, Précis Parasitol. 1912.

Discomyces Rivierei Neveu-Lemaire, Précis Parasitol. Hum. 43, 1921, non *Nocardia indica* Kanthack fide Froilano de Mello & Pais, 1918.

Oospora Rivierei Sartory, Champ. Paras. Homme Anim. 792, 1923.

Isolated from sputum and pus of a bronchopleuropulmonary infection followed by multiple miliary subcutaneous abscesses. Early symptoms those of tuberculosis, but *Mycobacterium tuberculosis* absent. Found pathogenic to laboratory animals by the use of a specialized technic.

Hyphae 1μ in diameter, arthrospores 1.5μ long by 1μ in diameter. Organism a strict aerobe.

Colonies on peptone agar small, conical, 1 mm. in diameter, powdery, growing to about 5 mm. in diameter, reverse yellow, medium blackened. On potato, growth slow, colonies appearing like little blocks of powder. Growth also slow on egg white, the substrate not digested. In liquid media, small grains size of a millet seed settling to the bottom, colonies floating, if not disturbed. Growth good on milk, forming a flesh-colored, whitish powdery pellicle with furrows. Fat assimilated, casein and lactose not perceptibly attacked, apparently only glycerol used from fat. Grown on 6% glycerol peptone agar, colony mammillate, white, powdery, furrowed, cork color, finally becoming black. Lactose, maltose, glucose, and fructose utilized. Gelatin liquefied.

Actinomyces Gibsoni Dodge, n. sp.

Streptothrix sp. Gibson, Jour. Path. Bact. **23**: 357, 358, 1920.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 776, 1923.

Isolated from enlarged spleen. Nonpathogenic to guinea pigs, rabbits, and mice, pathogenic to *Macacus* monkeys, organism being reisolated in one case from an enlarged spleen.

Gram-positive; aerobic.

Colonies on agar slants discrete, buff or white, hemispheric, becoming depressed and umbilicate. White efflorescence and musty odor. In peptone broth, there is a bottom growth of small, white "snowballs," with some eventually rising and floating on the clear medium. Neutral red lactose broth is unchanged. Milk coagulated in 4-5 days. Gelatin slowly liquefied with growth near surface.

Actinomyces Guegueni (Ota) Brumpt, Précis Parasitol. ed. 3, 1921; ed. 4, 1191, 1927.

Oospora lingualis Guéguen, C. R. Soc. Biol. **64**: 852-854, 1908; Arch. de Parasitol. **12**: 337-360, *21 figs.*, 1909.

Discomyces lingualis Brumpt, Précis Parasitol. ed. 1, 1910.

Nocardia lingualis Castellani & Chalmers, Man. Trop. Med. ed. 2, 819, 1913.

Nocardia Guegueni Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928, excl. syn.

Black pilose tongue by Guéguen along with *Cryptococcus linguae-pilosae* which later he thought to be the agent of the disease. Pathogenic for guinea pig.

Mycelium slender, spirals present, sometimes terminating in a chlamydospore. Chlamydospores commonly intercalary, ovoid, 1-3μ in diameter, conidia in chains, spherical, 0.8μ, on simple clavate conidiophores, 4-5μ. Optimum temperature 37° C., partial anaerobe.

In broth, white flocci at the bottom of the tube. On carrot, small white points 1-1.5 mm., later colored café-au-lait, with round protuberances, becoming powdery. On gelatin, colony white. Milk coagulated on third day, casein digested. Coagulated albumin digested. Nitrates reduced to nitrites, no gas.

Actinomyces Pinoyi (Froilano de Mello & St. Antonio Fernandes) Dodge, n. comb.

Nocardia Pinoyi Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 130, 1919.

Isolated from a case of erythrasma.

Cells 1-2μ in diameter, gram-positive, not acid-fast.

On agar, colonies moist, shining, whitish, margins irregularly dentate. On potato, colony dry, chestnut color, with small elevations, efflorescence chocolate color, medium colored deep brown. In broth, turbidity and sediment; slight pellicle on vegetable decoction. Milk coagulated in 72 hours, digested in 96 hours with odor of new leather, litmus decolorized.

Actinomyces goensis (Froilano de Mello & St. Antonio Fernandes) Dodge, n. comb.

Nocardia goensis Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 130, 1919.

A saprophyte, isolated from lesions of vitiligo.

Cells 5-40 × 0.8-1μ. Gram-positive, not acid-fast.

No growth on agar. On glycerol agar, colony white, dry, with slight efflorescence, resembling a bacterial colony. On glucose and maltose agars, colonies granular, opaque, milky white, thick. On potato, colony white, dry, viscous, cerebriform, becoming clear gray, efflorescence white; medium pigmented yellow, becoming brownish. On broth, pellicle thin, white; liquid turbid, sediment white. On sugar broths, pellicle better developed. Milk coagulated and digested, acidified.

Actinomyces Christophersoni (Froilano de Mello & St. Antonio Fernandes) Dodge, n. comb.

Nocardia Christophersoni Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 130, 1919.

Isolated from the air.

Cells 30-70 × 0.6-0.7μ, gram-positive, not acid-fast.

On agar, colony moist, creamy, without efflorescence; on sugar agars, similar or slightly yellowish and waxy. On potato, colony elevated, cream yellow, becoming dry and whitish, waxy, no pigmentation of medium. On carrot, colonies similar, moist, granular, resembling butter. On broth, a strong white pellicle, not adherent, white sediment, slight turbidity. On glucose broth, similar but yellowish on vegetable decoctions, pellicle grayish, sediment sandy. Milk coagulated and slightly digested, acidified.

Actinomyces pyogenes (Chalmers & Christopherson) Dodge, n. comb.

Streptothrix pyogenes Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 270, 1916.

Streptothrix sp. Caminiti, Centralbl. Bakt. I, **44**: 193-208, *4 pls.,* 1907.

Isolated from the air. Found pathogenic to rabbit, guinea pig, and dog.

Generally hyphae are present in young colonies, in old colonies bacilliform spores. Growth very slow under anaerobic conditions, diastase present.

Colonies white, opaque, wavy, margin elevated, center umbilicate, efflorescent. On 2% glycerol agar, colonies dry, gray white, elevated, adherent. Growth rapid. On potato, colonies small, umbilicate, soon confluent, white or yellowish. On blood serum, colonies white, adherent. On blood serum with glycerol, colonies opaque, gray green, with the medium tinted slightly violet. Colonies in broth, floating both at top and at bottom, the former forming a pellicle at first white, then darker, the medium remaining clear. In serum broth, colonies are gray white. Colonies brown ochraceous or dark brown in glycerol broth. The higher the percentage glycerol, the darker the colony color on all media. On milk, a greenish pellicle, opaque and folded, forms. It becomes dark green in 2 weeks. A flocculent coagulum settles. Gelatin liquefied.

This organism is near to *Actinomyces albus,* to which Chalmers & Christopherson reduce it.

Actinomyces gypsoides Henrici & Gardner, Jour. Infect. Dis. **28**: 232-248, 1921.

Oospora gypsoides Sartory, Champ. Paras. Homme Anim., 802, 1923.

Isolated from the sputum of a patient suffering from cough with pains in the chest. Pathogenic to rabbits and guinea pigs.

Colonies star-shaped. On agar, they are thin, grayish, soon becoming thick, opaque, and chalky white. Surface dry and wrinkled, adhering to the medium, breaking away only in large flakes. Mycelium is buff-colored below the efflorescence. Growth on sugar agars more rapid, but otherwise similar. Similar also on potato. Stratiform superficial growth on gelatin. In liquid media, small snow white flakes appear, presently coalescing into a thick, wrinkled, snow white pellicle and broad ring. After 2 weeks the pellicle breaks and settles. No further growth occurs. In litmus milk, there is a similar pellicle but with a yellowish tinge. At first alkaline and curdled, then litmus reduced and casein digested in 2 weeks. Meat extract media, also Dunham's peptone, darken, becoming brownish. Organism grows also on Czapek agar and on soil infusion agar. No hemolysis of blood agar. Gelatin liquefied. Neither serum nor Dorsett's egg medium digested.

Actinomyces invulnerabilis (Acosta & Grande Rossi) Dodge, n. comb.

Cladothrix invulnerabilis Acosta & Grande Rossi, Cronica Méd. Quirúrg. Habana **19**: 97-100, 1893.

Isolated as laboratory contamination, and also from water; not pathogenic for laboratory animals.

On agar, colonies small round dirty white, becoming dull white, margins elevated, adherent to substrate; surface with radial furrows; reverse yellow. On glycerol agar and potato, growth similar.

On gelatin, colony silvery white, center depressed, velvety, liquefying the gelatin slowly. On potato, colonies white, chalky, earthy odor, potato blackening. On milk, coconut milk, and broth, yellow solid pellicle (tube can be inverted without flow) milk digested (?).

Very resistant to heat, resisting 6 discontinuous sterilizations at 100° C., grows in 1% boric acid.

Actinomyces roseus Namysłowski, Centralbl. Bakt. I, **62**: 564-568, 1912.

Actinomyces sp. Löwenstein, Klin. Monatsbl. Augenheilk. N. F. **10**: 203-207, *4 figs.*, 1910. Not *Nocardia rosea* Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 270, 1916, which is *A. roseus* Krainsky, Centralbl. Bakt. II, **41**: 649, 1914.

Hyphae 6-8μ, richly septate, branched.

Colonies on agar and potato, chalky white; on glycerol agar, delicate rose. Colonies cerebriform and chalky white on gelatin. In broth no turbidity. Growth on lactose litmus the same as on sugar. All colonies have musty odor. No growth on milk or plum decoction, slight growth on egg white. Coagulated ox blood serum liquefied after a few days. Gelatin not liquefied.

Actinomyces candidus Petruschky in Kolle & Wassermann, Handb. Path. Mikroorganismen **2**: 832.

Streptothrix gedanensis II, Petruschky 1898, Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 158, 1918.

Streptothrix lathridii Petruschky, 1898.

Nocardia candida Castellani & Chalmers, Man. Trop. Méd. ed. 2, 818, 1913.

Discomyces candidus Verdun & Mandoul, Précis Parasitol. 754, 1924.

Found in sputum.

Aero-anaerobe. Surface of colony on potato velvety with chalky efflorescence. Serum and gelatin liquefied.

Actinomyces albus (Rossi-Doria) Gasperini in Lehmann & Neumann, Atlas Grundr. Bakt. **2**: 383, 1896 excl. syn.

Actinomyces chromogenes β. Gasperini, 18.

Streptothrix Foersteri Gasperini, Ann. Microgr. **2**: 449-474, *Pls. 5-7*, 1890, non aliorum.

Streptothrix alba Rossi-Doria, Ann. Ist Ig. Sperim. Univ. Roma N. S. **1**: 399-438, *Pl. 8*, 1891.

Oospora Doriae Sauvageau & Radais, Ann. Inst. Pasteur **6**: 242-273, 1892.

Actinomyces bovis albus Gasperini, Centralbl. Bakt. I, **15**: 684, 1894.

Cladothrix alba Macé, Traité Pratique Bact. ed. 3, 1897.

Nocardia alba Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 105, 1919.

Reported by Massaglia from a case of tuberculosis, 1904; probably also case I of Chatschaturjan et al. (1933). Animal inoculations gave lesions of pseudotuberculosis.

Not acid-fast. Aerobe, growing only slightly under anaerobic conditions.

On maltose peptone agar, colony verrucose, wrinkled, waxy, grayish white, light amber yellow margin with a chalky efflorescence, but no pigmentation of the medium. On potato, colony wrinkled, grayish to yellow or brown with a chalky efflorescence, diastatic action and brown pigmentation of the medium. On gelatin, a yellowish white flocculent mass on surface with center brown. Fir tree arborescence in the medium. In peptone beef broth, there is a sediment of discrete opaque, white, flocculent colonies. No pigmentation of the medium. Litmus milk at first becomes pink, then a clear red brown, and alkaline. Horse serum is completely liquefied with the formation of a brown pigment. Gelatin is also liquefied.

Actinomyces Garteni Brumpt, Précis Parasitol. ed. 4, 1191, 1927.

Cladothrix liquefaciens No. 2. Garten, Deutsch, Zeitschr. Chirurg. **41**: 257-285, *Pl. 6,* 1895.

Discomyces Garteni Brumpt, Précis Parasitol. ed. 1, 1910.

Oospora Garteni Sartory, Champ. Parasit. Homme Anim. 778, 779, 1923.

Nocardia Garteni Gougerot, Gaz. des Hôp. **86**: 199, 1913.

Isolated from abscesses. Pathogenic to rabbits, guinea pigs, and pigeons.

Colonies on agar much wrinkled, gray white, shining, with a chalky efflorescence; later penetrating and darkening the medium. On glycerol agar, growth is slower, moist, and shining, with no efflorescence. Organism grows on potato, better at 37° C. than at 22° C., with a white efflorescence formed and potato discolored on the surface. Small grayish white adherent colonies on gelatin. In broth or blood serum, there is a grayish white deposit of flocculi, surface colonies showing the efflorescence. Solid blood serum is liquefied in 6 days, the liquid remaining clear. Gelatin also liquefied.

Actinomyces Nicollei (Delanoë) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 36, 1934.

Nocardia Nicollei Delanoë, Arch. Inst. Pasteur Tunis **17**: 257-274, *3 figs.,* 1928.

Isolated from a voluminous mycetoma of the thigh in the tribe Oulad Bou Zerrara, Morocco. It began with inguinal adenitis and developed slowly, with no pain. Right leg larger than left, lesions on the upper two-thirds of the thigh violet in color, producing pus with small yellow grains. Medication with KI helped somewhat, but patient not hospitalized long enough for a cure to be effected. Patient died six months later. Reported as not pathogenic to animals, but pathogenicity tested only after organism had been cultivated four years on potato. Grains yellowish white, 0.5-0.8, rarely 1 mm. in diameter, easily crushed, becoming ochraceous on drying.

Hyphae branched, not over 1μ in diameter, nonseptate, no nuclei observed. Terminal, sporiferous portion of hypha is abjointed from the rest. Spores spherical, 0.3-0.7μ (also reported 1μ) in diameter, not easily staining. Chlamydospores deeply staining. Gram-positive, not acid-fast. Optimum temperature 25°-30° C., growth between 15° and 37° C.

Colonies, on Sabouraud glucose agar, small, round, elevated, uneven, mammillate, snow white, dry, chalky, hard, crushing with difficulty. Subcultures gradually die out on this medium. On Langeron 8% sugar agar, very old colonies show a slight rose color. On simple agar, colony whitish, granular, humid, adherent, older colonies becoming folded and cerebriform, covering the surface of the agar and being somewhat sunken in the agar at the margins. An efflorescence appears on the third day, with greater elevation. On potato, with or without glycerol, colonies become confluent, forming whitish cordons, sometimes sinuous, the chalky surface mammillate and uneven covering the whole surface after several subcultures, turning yellowish in age with the substrate becoming greenish. On carrot, colonies creamy, slightly yellowish, later becoming chalky and white with carrot browning. In potato juice* a fine white powder appears at the surface with white floating crateriform colonies. These are dry, 0.2-0.25, up to 0.5 mm. in diameter. Later, center of crater is elevated, yellowish, waxy, finally confluent, forming a waxy, thick, yellowish folded pellicle with a fine white efflorescence. In carrot juice, prepared as the first method for potato juice,* there is growth both in depths and at the surface. Medium remains clear, colonies grayish white, not dry. Ring prominent, 6-7 mm. above the liquid. Pellicle is thick, folded, and gray with a white efflorescence, lower surface being black and liquid amber. In broth, growth is somewhat as in carrot juice, but no pellicle forms, and ring is not very adherent. Starch medium is liquefied. No fermentation of glucose, fructose, maltose, sucrose, or lactose. Serum is completely liquefied. Gelatin also liquefied with the formation of a golden yellow pellicle. Odor of cultures moldy.

Actinomyces Dassonvillei (Liégard & Landrieu) Brumpt, Précis Parasitol. ed. 4, 1191, 1927.

Nocardia Dassonvillei Liégard & Landrieu, Ann. d'Occulistique **46**: 418-426, 1911.

Discomyces Dassonvillei Neveu-Lemaire, Précis Parasitol. Hum. 42, 1921.

?*Streptothrix Foersteri* Gasperini, Ann. Microgr. **2**: 449-474, *Pls. 5-7,* 1890, *non aliorum.*

Originally isolated from a case of conjunctivitis. Potron (1913) states that this species is pathogenic for man and rabbits. Since I have not been able to locate the original description, the following is taken from the paper by Potron & Thiry (1913).

Hyphae 0.5-0.7μ in diameter, branched, septa not seen. Arthrospores ovoid, in chains, not staining, highly refringent.

On solid media, colonies acuminate, white, dull, chalky, very difficult to separate from contaminating bacteria. On potato, colonies white, soon chalky, covering the whole surface of the medium, which is colored violaceous at first. Colonies become deep green (*vert foncé*), with guttation of greenish drops in old cultures. When the drops are removed, the colony is grayish green with a moldy odor. On carrot, growth slow, chalky, pure white and very thin. No growth on turnip. On broth, also asparagus and maltose broth, grayish flocci at bottom of tube, liquid clear, some flocci adhering to the walls, or if they reach the surface they become chalky and float; color of broth deepens; odor is slightly moldy. On coagulated egg albumen, colony chalky, medium becomes translucent, then brown, and is partially liquefied. On serum, growth slow with partial liquefaction of medium. Milk slowly coagulated then the coagulum is digested, leaving a clear brown liquid in which the colonies sink.

---

*Put 250 gm. grated potato in 500 c.c. water, triturate, decant, and filter. Sterilize at 115°-120° C. Alternate method; cover pulp with water, autoclave 15 minutes at 115°-120° C. decant, filter, and sterilize as above.

Most recent authors have referred *Streptothrix Foersteri* Gasperini to this species, but since it differs in some respects, I shall give the description below:

Streptothrix Foersteri Gasperini, Ann. Micrographie **2**: 449-474, *Pls. 5-7,* 1890 *non aliorum.*

The cultures appeared as contaminants from the air.

Mycelium 1μ in diameter, spores 1-1.5μ in slightly curved terminal chains.

Colony on gelatin at room temperature, round, elevated, moist, slightly yellowish at first, becoming more elevated, white, powdery, medium liquefied late and very slowly. Agar colonies round, hemispheric with zones of sporulation, otherwise similar to gelatin colonies. Serum slowly liquefied. Little growth on cooked potato. On broth, a thick pellicle is produced.

Probably the organism isolated from vaccine from heifers by Sabrazès & Joly, C. R. Soc. Biol. **50**: 134, 135, 1898, also belongs here.

Actinomyces minimus (LeCalve & Malherbe) Dodge, n. comb.

Oospora forme de *Microsporum* [*Audouini* var. *equinum*] Bodin, Arch. de Parasitol. **2**: 606-609, 1899.

Trichophyton minimum LeCalve & Malherbe, Arch. de Parasitol. **2**: 218-250, 489-503, 1899; Ibid. **3**: 108-110, 1900.

Microsporum minimum Castellani & Chalmers, Man. Trop. Méd. ed. 3, 993, 1919.

Isolated from ringworm of horse and dog. Sabouraud suggests that this was a saprophyte, as Bodin was unable to repeat the results of LeCalve and Malherbe.

On Sabouraud agar, surface becomes covered with yellowish gray elevations, 6 × 4 × 1.5-2 mm. high. Colonies on beef agar circular, little elevated, with sinuous rays. Center elevated, grayish, powdery. On oatmeal agar, growth shows colony with irregular margins, eroded, granular, yellowish. Colonies on potato are cerebriform, sinking into the medium, white. On serum gelatin, there appears a grayish white efflorescence. Growth on horsehair is in the form of irregular plaques, 10-15 mm. in diameter, yellowish gray, slightly elevated, chalky. On straw, colony is irregular and grayish. In turnip broth, there are floating powdery islets and spongy, mucoid sediment. In oatmeal broth, growth is more rapid, with a sort of grayish pellicle forming. In carrot broth, growth still better; in potato broth, still better. Pellicle is grayish, umbilicate with the central elevation surrounded by a moat and a flat marginal zone. Reverse brownish yellow. In Raulin's solution containing 2% peptone, mucoid masses, suspended or settling, are slowly formed. Starch is hydrolyzed. Milk is peptonized without coagulation. Gelatin is liquefied.

Actinomyces radiatus Namysłowski Bull. Internat. Acad. Sci. Cracovie Cl. Sci. Math. Nat. **1909**: 418-426, *Pl. 21*, 1910.

Found in infection of the cornea.

Hyphae about 1μ thick, branched, producing spherical to ellipsoid spores.

On ordinary agar, colony gray, with an elevated center and round margin, central elevation more or less cruciform or star-shaped. On glycerol agar, growth is flat, round, crateriform, with concentric growth zones, white. On coagulated blood serum, colonies round, confluent with white efflorescence. Serum liquefied. On egg white, colonies white. Gelatin is liquefied, with a sediment of gray white colonies and a white pellicle. In broth, a gray white sediment, medium clear. Milk digested, finally becoming brown with thin white pellicle. No growth on sugar agar, pear, potato, bread, or carrot.

Actinomyces rubidaureus Lachner-Sandoval, Über Strahlenpilze 66, 1898.

Cladothrix Thiry, Arch. Physiol. Norm. Path. **8**: 283-288, 1897.

Actinomyces mordoré Thiry, Thèse, Nancy 82-93, 1900.

Nocardia modoré Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 265, 1916.

Nocardia Thiryei Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 193, 1918.

Actinomyces Thiryi Sartory & Bailly, Mycoses Pulmonaires 252, 1923.

Oospora mordoré Sartory, Champ. Paras. Homme Anim. 824, 1923.

Isolated from a case showing anginous exudate with edema.

Hyphae branched, spores on erect branches, hyaline.

This organism is a strict aerobe; gram-positive.

On Sabouraud conservation agar, colonies circular, elevated, isolated, grayish or violaceous, with a white efflorescence and surrounded by reddish brown aureole, shining. This metallic lustre is produced by lamellar crystals with a clear amethyst violet and ruby red center. The medium browns sometimes. On glycerol peptone agar, colony yellow, ochraceous or brownish, violet or white, without the metallic lustre. On potato, colonies are rose, grayish verrucose; the medium browns and has an eroded (literally "worm-eaten") appearance. On gelatin, there forms a pellicle, yellow gray at the surface, with efflorescence and crystals, less colored than on agar. On peptone and peptone broth, a ring or pellicle with floccose sediment. Serum and egg albumen are liquefied with a strong odor of trimethylamine. Gelatin is rapidly liquefied. Milk is coagulated and rapidly peptonized.

Actinomyces Avadi Dodge, n. sp.

Streptothrix Madurae Koch & Stutzger, Zeitschr. Hyg. **69**: 17-24, 1911. non Vincent, 1894.

Isolated from a Madura foot in Egypt, case of Dr. Avad. Nonpathogenic to experimental mammals, pathogenic to frogs.

Mycelium 0.3-0.5μ in diameter, branched at right angles. In young colonies hyphae break up into ovoid or spherical spores. Gram-positive. Growth aerobic, optimum temperature being 22° C., growth poor at 37° C.

Organism grows on coagulated horse serum, glucose agar, simple agar, abundance of growth decreasing in that order. Colonies white, later brownish, adherent, confluent with a wavy, shining surface resulting, which is dull and brown in old cultures. On ascitic agar, colonies are thin and growth is slow. Growth also slow on potato. In peptone solution, colonies 3-4 mm. in diameter, white, filling bottom of the tube and adhering to the walls. In broth, to which three parts horse serum has been added, there is a delicate white pellicle which sinks easily, a slight ring, and sediment similar to that in peptone solution. No growth at 37° C. In simple broth, no pellicle, growth as in peptone solution but less abundant. The addition of glucose does not alter this. Glucose and lactose unchanged. In milk, there is bottom growth, no color change in litmus. Milk coagulated in 2-3 days, curd digested in 4-6 weeks. Gelatin slowly liquefied, colonies gradually sink to the still solid substrate and eventually to the bottom of the tube. Coagulated serum digested.

Actinomyces Levyi Dodge, n. sp.

Actinomyces sp. Levy.

Oospora sp. Sartory, Champ. Paras. 827, 1923, with incorrect reference.

Sartory states: Isolated from pus. Not pathogenic for guinea pigs or white rats. Shining orange colonies on all media. On agar, colonies thick, adherent, without chalky efflorescence. Gelatin and serum liquefied. On broth, isolated colonies along the walls of the tube. No growth on potato. On litmus milk, an orange color at the surface, no change of acidity, gradually digested. Starch completely hydrolyzed.

Actinomyces bovis Harz, Centralbl. Med. Wiss. **15**: 485, 1877; Jahresber. München. Zentral Thierärzeneischule, 781, 1877.

Discomyces bovis Rivolta, Clin. Veterinaria **1**: 208, 1878.

Bacterium actinocladothrix Afanassiev, St. Petersb. Med. Woch. **13**: 84, 1888.

Nocardia actinomyces Trevisan, I Genere e le specie delle Batteriacee 9, 1889.

Cladothrix bovis Macé, Traité Practique Bact. ed. 2, 666, 1891.

Streptothrix actinomyces Rossi-Doria, Ann. Ist. Ig. Sperim. Univ. Roma **1**: 405, 1892.

Oospora bovis Sauvageau & Radais, Ann. Inst. Pasteur **6**: 271, 1892.

Actinomyces bovis sulphureus Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Nocardia bovis Blanchard in Bouchard, Traité Path. Gén. **2**: 857-868, 1895.

Cladothrix actinomyces Macé, Traité Practique Bact. ed. 3, 1038, 1897.

Streptothrix actinomycotica Foulerton, Lancet **2**: 780, 1899.

Streptothrix bovis communis Foulerton, Jour. Comp. Path. Therap. **14**: 50, 1901.

Streptothrix bovis Chester, Man. Determinative Bact. 361, 1901.

Sphaerotilus bovis Engler, Syllabus Pflanzenfam. ed. 5, 5, 1907.

This organism is the common cause of actinomycosis or lumpy jaw in cattle. Many strains, which probably belong elsewhere, have been referred here. In view of this confusion, Puntoni (1931) would discard the name altogether, in favor of the later more carefully described species of Gasperini and others. Apparently current usage tends strongly toward the identification of *A. bovis* with *A. sulfureus* of Gasperini. The following species description is taken from Froilano de Mello & Pais (1918), from Bergey (1923), and from Puntoni's description of *A. sulfureus.*

Slender branching hyphae, 0.4-0.6μ in diameter. Large club forms are seen in animal tissues; gram-positive.

Colonies on glycerol agar, waxy, smooth, yellowish, umbilicate cartilaginous, adherent to the medium. In age, they tend to become brown and color the medium. They are covered with a sulphur-colored efflorescence. On synthetic agar, growth restricted, yellowish aerial mycelium appears late, becoming light sulphur yellow, powdery. On starch agar, dirty yellow. On plain agar, colony abundant, cream colored, becoming fawn colored, brown or almost black. On gelatin stab, inverted fir tree, colonies on surface opaque, white, punctiform. On coagulated serum, colonies similar but larger, adherent, no pigmentation. On potato, growth abundant, wrinkled, gray to canary yellow; starch hydrolyzed. On carrot, whitish gelatinous colony not adherent. On glycerol broth and other liquid media, no pellicle, sediment of punctiform colonies. (Bergey reports thin yellowish pellicle.) Milk slowly coagulated and digested, sugars not fermented. Gelatin and serum digested. Acid in glucose, lactose, sucrose, maltose, and glycerol. Optimum temperature 37° C.

Actinomyces Lanfranchii Sani, 1916.

Nocardia Lanfranchii Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 178, 1918.

Isolated by Finzi from glandular and ganglionar actinomycoses of ox.

Gram-negative. Otherwise very close to *A. bovis* [original description not seen].

Actinomyces liquefaciens (Hesse) Brumpt, Précis Parasitol. ed. 4, 1192, 1927.

Cladothrix liquefaciens Hesse, Deutsche Zeitschr. Chirurg. **34**: 275-307, *Pls. 11, 12,* 1892.

Nocardia liquefaciens Castellani & Chalmers, Man. Trop. Med. ed. 2, 818, 1913.

Discomyces liquefaciens Neveu-Lemaire, Précis Parasitol. Hum. 42, 1921.

Oospora liquefaciens Sartory, Champ. Paras. Homme Anim. 778, 1923.

Streptothrix buccalis Goadby, 1903, non Roger, Bory & Sartory.

Isolated from a mycosis of the inguinal region, showing light yellow grains.

Spores short, coccoid. Organism is a strict aerobe, gram-positive.

Cultivable with difficulty. On glycerol agar, colonies confluent, giving a thick, snow-white covering, reverse dark yellow after two months, strong odor, suggesting Camembert cheese, adherent. Growth on potato, straw yellow, not coloring the medium. In broth, small flocci appear at the bottom of the tube, each being white above and yellowish white below. Medium remains clear, darkening in 7-8 months. On coagulated serum, colonies small, light yellow, becoming snow white after 5 days. There is some liquefaction, and the colony sinks in two months, showing hard yellow grains, partly as a result of incrustation by salt crystals. Gelatin liquefies in one week and the colony sinks, unless it happens to stick to the walls of the tube, when it forms a white partial pellicle. Liquid is clear, darkening after 7-8 months.

Actinomyces aureus (DuBois Saint-Severin) Lachner-Sandoval, Über Strahlenpilze 66, 1898.

Streptothrix aurea DuBois Saint-Severin, Ann. Méd. Nav. Colon. **63**: 253-260, 1895; Semaine Méd. **15**: 202, 1895.

Nocardia aurea Castellani & Chalmers, Man. Trop. Med. ed. 2, 818, 1913.

Oospora aurea Sartory, Champ. Paras. Homme Anim. 812, 1923.

Isolated from case of conjunctivitis. Not pathogenic to laboratory animals.

Hyphae 1μ in diameter, dichotomous, with helices which break up into ovoid arthrospores. Gram-positive.

On agar, colonies thick, dry, acuminate, verrucose, convoluted, covered with a white powder. Reverse yellow. On potato, colony dry, verrucose, thick and yellow (color like that of gold chloride). Spores white. On coagulated serum, colonies gray, moist, horny, liquefying substrate. On human serum, colony flat, thin, circular, with alternating zones gray depressed and white powdery; reverse yellowish. On gelatin, there is a thick, contorted, superficial colony, the gelatin becoming liquefied in a few days, with the center depressed and darkening, the white powdery portion submerged and yellowish. In broth, small spherical masses form on the surface and settle to the bottom. Gelatin and coagulated serum liquefied.

Actinomyces luteolus (Foulerton & Jones), Brumpt, Précis Parasitol. ed. 4, 1192, 1927.

Streptothrix luteola Foulerton & Jones, Trans. Path. Soc. London **53**: 75, 1902.

Oospora luteola Sartory, Champ. Paras. Homme Anim. 812, 1923.

Nocardia luteola Castellani & Chalmers, Man. Trop. Med. ed. 2, 818, 1913.

Discomyces luteolus Verdun & Mandoul, Précis Parasitol. 750, 1924.

Isolated from a case of purulent conjunctivitis wtih sloughing of cornea. Not pathogenic to ordinary laboratory animals.

The organism is an aerobe, showing only scanty growth under anaerobic conditions. Optimum temperature 37° C. Gram-positive, not acid-fast.

On peptone maltose agar, growth is a faint drab or whitish, later becoming faintly yellow. Colony on potato, café-au-lait in color, with no pigmentation of the medium. Efflorescence only at 37° C. Growth on horse serum, dry and wrinkled, with a drab growth sunk in the medium. On gelatin, colony opaque white faintly tinged with yellow, sinking into substrate as it liquefies.

No pigmentation of substrate. Litmus milk is slightly acidified, but there is no coagulation. Litmus is slowly decolorized and the milk clears. Gelatin and serum somewhat liquefied. On peptone beef broth, sediment of discoid colonies. Slightly feculent odor in old cultures.

The following two species belong in this group but are too briefly described to place more definitely.

Actinomyces appendicis (Chalmers & Christopherson) Brumpt, Précis Parasitol. ed. 4, 1189, 1927.

Nocardia appendicis Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 256, 1916.

Streptothrix hominis III, Foulerton 1906, 1910.

Isolated from a case of appendicitis and right iliac abscess.

Colonies on agar are yellow, on potato, brown, aero-anaerobic. Gelatin and coagulated serum liquefied.

Actinomyces Salvati Langeron, Bull. Soc. Path. Exot. **15**: 526-528, 1922; Fontoynont & Salvat, Bull. Soc. Path. Exot. **15**: 596-607, 1922.

Isolated from generalized nodular lesions in the Madagascar rat.

Mycelial elements rare in pus. In culture, mycelium filamentous, branched, fragmenting into coccoid or bacilloid arthrospores. Hyphae swell terminally. Sometimes chlamydospores form from terminal thickenings. Gram-negative, not acid-fast.

Cultures at 37°-38° C. brownish, more or less dark, finally covered with a chalky white efflorescence. Odor mouldy. Cultures on agar with glycerol, glucose, or maltose very adherent to the substratum. Organism grows well on carrot, turnip, potato. Coagulated serum is slowly liquefied with a repulsive odor.

Actinomyces gedanensis (Scheele & Petruschky) Brumpt, Précis Parasitol. ed. 4, 1196, 1927.

Streptothrix sp. Scheele & Petruschky, Verh. Kong. Innere Med. 550, 1897.

Streptothrix gedanensis I Scheele & Petruschky.

Nocardia gedanensis Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916.

Isolated from sputum and pus.

On agar, colony completely white with strong odor adherent to substrate. On gelatin, colony white. No growth on potato or glucose agar.

Actinomyces catarrhalis (Sartory & Bailly) Brumpt Précis Parasitol. ed. 4, 1195, 1927.

Oospora catarrhalis Sartory & Bailly in Bailly, Contr. à l'Étude des Mycoses Pulmonaires. Thèse Univ. Strasbourg Fac. Pharm. **4**: 57-82, 1921.

Isolated from sputum in a case of cough. Pathogenic to guinea pigs.

Hyphae 0.4-0.5μ in diameter, long, branched, curved. Sporiferous branches close together. Spore chains coiled, but older hyphae not helical. Spores 0.5-0.6μ in diameter. Optimum temperature between 32°-35°, but growth very good at 37° C.

No growth on carrot, potato, banana starch, turnip, artichoke or Raulin agar. Grows on gelatin, agar, sugar agars, prune decoction with agar or gelatin. Sabouraud, beef broth, and maltose media are best. On gelatin, small punctiform grayish colony. On carrot, small punctiform colonies, grayish white, then after a week becoming cacoa brown, discrete. Colonies similar on banana, but remain white. In beef broth, a thick mucous deposit, no pellicle. On other liquid media colonies are similar. Milk is coagulated on the second day and then the coagulum digested. Gelatin not liquefied.

Actinomyces Matruchoti (Mendel) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 51, 1934.

Cladothrix Matruchoti Mendel, C. R. Soc. Biol. **82**: 583-586, *2 figs.*, 1919.

Isolated from the roots of a decaying tooth with tumefaction. Slightly pathogenic to rabbit on intramuscular injection.

Hyphae straight or sinuous, variable in length, 100 × 0.3-0.5μ approximately, nonseptate, generally not branched. Branching false(?). In old cultures, hyphae fragment into segments 4-5μ long. Organism a strict aerobe. Gram-positive, not acid-fast.

On ascitic agar, colonies gray, opaque, irregularly circular, adherent, not over 1 mm. in diameter, central zone elevated, yellowish, slightly umbilicate. Later, periphery becomes transparent and radiate. On potato and carrot, growth poor except in liquid of condensation. No growth on gelatin. In broth and peptone solution, small yellow grains are suspended in the liquid, then fall to the bottom, leaving the liquid clear. Litmus milk becomes red, with lower layer decolorized. Acid formation with glucose, lactose, fructose, sucrose. Milk coagulated, gelatin not liquefied.

Actinomyces Rodellae Dodge, n. sp.

Streptothrix sp. Rodella, Centralbl. Bakt. I, **84**: 450-461, 1920.

Isolated from abscesses of the tooth and jaw.

Hyphae short, branched. Gram-positive and negative.

On agar, colonies small, irregular, dry, efflorescent. No growth on potato or gelatin. Colonies on serum depressed, wavy, compact, almost leathery, dirty gray, adherent, though whole colony may be removed without breaking. In broth, growth slow with deposit settling and medium clear. In sugar broth as in simple broth, but growth more abundant, granules up to the size of petit pois. Milk is digested and cleared.

The author identifies his organism with *Micromyces Hofmanni* Gruber.

Actinomyces Chalmersi (Froilano de Mello & St. Antonio Fernandes) Dodge, n. comb.

Nocardia Chalmersi Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 130, 131, 1919.

Isolated from saliva of horse.

Cells 3-5 × 0.5-0.7μ, gram-positive, acid-fast.

Colonies on agar, dry, granular transparent at first, becoming white with white efflorescence. Similar on glycerol, maltose, and Sabouraud agar. On potato, colony dry, membranous, folded, dirty white, growing along walls of tube, finally reticulate, brownish. On carrot, colony similar, folds thinner and disappearing in age; yellowish white becoming brownish yellow. On broth, pellicle white, folded, adherent, medium remaining clear. On sugar broths similar, but folds more highly developed. On vegetable broth, pellicle grayish white, sediment sandy. Milk coagulated and digested, with yellowish white pellicle. Litmus milk decolorized. No diastatic action.

Actinomyces Tarozzii (Miescher) Dodge, n. comb.

Streptothrix Tarozzii, Miescher, Arch. Derm. Syphilis **124**: 297-442, *Pls. 20-25*, 1917.

Actinomyces albus Tarozzi, Archivio Sci. Med. **33**: 553-632, 1909.

Isolated from a case of Madura foot with yellowish white granules. Pathogenic to laboratory animals.

Hyphae 0.5-1.5μ in diameter, repeatedly dichotomously branched, occasionally septate. Chlamydospores terminal, spherical, single, 4-5μ in diameter. This organism is a strict aerobe, grows at 15°-20°, better at 37° C. Gram-positive, not acid-fast.

Growth on agar opaque, glassy, smooth, adherent with, sometimes, a white efflorescence. Colonies on glycerol agar velvety, snow white, soon confluent. On potato or potato glycerol, colonies hemispheric, concave below, adherent to the substrate, finally, confluent into a mammillate white, velvety colony, turning brown and black below, remaining white above. Dark color not formed on new potatoes. Velvety white colonies on gelatin. On coagulated blood serum, development is slow, with the small hemispheric colonies adherent to the substrate and becoming dry without the formation of aerial hyphae. In broth cultures, both beef and potato, the deposit is composed of small gelatinous colonies which are finally confluent into a mucoid mass. Surface colonies develop a white aerial mycelium with liquid remaining clear, moldy odor. No growth on hay infusion. Gelatin slowly liquefied.

Actinomyces Ribeyro, Dodge, n. sp.

Hongo artrosporado Ribeyro, Ann. Fac. Méd. Lima **3**: 1-5, *1 pl.,* 1919.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 810, 1923.

Isolated from a generalized infection on the arms, legs, and chest in a patient from Cotabambas, Apurímac, Peru. There were from 30 to 40 discrete pustules in various stages of development. These start as small red papules, become acuminate, 1-2 cm. in diameter, yellowing with the central eminence and serous content darkening. On rupture, a dark crust forms and a lively burning pain is provoked for a few days. Finally the crust disappears, without leaving a scar. Not pathogenic to rabbit except on subcutaneous inoculation, when typical nodules are produced.

In tissues, coccobacilli, 1-2 × 1μ, straight or slightly curved. Mycelium fine, branched, 0.5μ in diameter, not septate. Sporulation in about 20 days.

Colonies slightly elevated, creamy in consistency and color, with a white, powdery efflorescence. Very little or no growth on Sabouraud agar. In broth, there is a fragile pellicle and sediment. Growth on gelatin creamy, then powdery white. Substrate not liquefied.

Actinomyces keratolyticus Acton & McGuire, Indian Med. Gaz. **66**: 65-70, *3 pls.*, 1931.

Produces cracked heels among the ryots of India. The disease known to the medical profession as keratolysis plantare sulcatum or keratodermia plantare sulcatum is known in Bengali as *chaluni* (literally, a sieve) from the pitted condition of the thick skin of the feet, or *haja* from the sodden condition of the skin between the toes which often splits, giving rise to the deep type of *mango toe* or *phata*, from the cracked and fissured condition of the heel. In Urdu it is called *panki* from its association with mud (*pank*).

The thick horny skin of the plantar surface is dissolved in grooves. The thick sodden skin between the toes is suggestive of conditions produced by *Epidermophyton* in such positions, see p. 438. The epidermis on the sides of both toes at the interdigital cleft is thickened, white, and sodden in appearance. On separating the toes a deep fissure extends through the corium into the subcutaneous tissues which is extremely painful and is likely to be infected by *Streptococci*. At other times, the infection produced an intertrigo between the web of the fingers or toes and extends to the thick palmar or plantar surface as a gyrate area of keratolysis. The cracked or split heel during the monsoon is usually due to *Actinomyces keratolytica*, while during cold weather it is produced by other agents.

Ulcus interdigitale (Castellani 1907, Breinl 1915, Martinez & Lopez 1918) seems to be produced by the same organism. Pruritus between the toes is followed by deep fissure which gradually develops into a large oval ulcer. The margins consist of heaped up, sodden epithelium, and the base is a dull dark red color. There is little or no discharge, and these ulcers are very painful. The ulcers may also appear on the sole near the tread of the great toe and heel. Sometimes these lesions extend very deeply into the interdigital cleft and may even necessitate amputation of the toe by secondary sepsis. Breinl (1915) described an extreme form (ulcus interdigitale destruens). The lesion starts as a small fissure which gradually forms a painful ulcer and then spreads quite rapidly upward toward the toe and down to the sole. The ulcer is deep and has irregular edges, and the granulation tissue is covered by an irregular dirty gray scab. The floor of the ulcer is reddish and uneven and discharges much thick yellow pus. The ulceration may spread upward between the toes and gradually lead to complete loss of the affected toe. When healing occurs without amputation, the adjoining surfaces of the toes may grow together. The ulcers are very chronic and may cause considerable deformity.

The disease is usually contracted by walking about barefooted on damp soil, contaminated by horse or cow manure. The ryots and maid servants who are continually walking on damp soil are prone to the disease of the feet, while the malis (gardeners) more frequently develop paronychia with greatly thickened skin margins, or onychomycosis with the base of the nails becoming brittle and moth-eaten in appearance. The lesions usually occur during the monsoon months (August to October). The disease has been twice observed in European officers of coastal vessels who were accustomed to walk about the decks with bare feet in the early morning while supervising washing the decks. Not pathogenic to experimental animals, but the disease was produced on a human volunteer, and the organism recovered. The lesions clear up on treatment with a formalin lotion. Cultures inhibited by gentian violet 1:400,000 and 5% solution used in treatment.

Tissue stained by Ponder's method shows the very slender mycelium, either nonseptate or closely septate, suggesting a string of *Streptococci*. The organism is best isolated on Norris' medium.

The hyphae are very slender, 0.8μ in diameter, differentiated slightly into aerial hyphae, surface runners and rooting hyphae extending into the agar. The terminal organs are of two kinds: terminal spindles, slightly curved, composed of 2-3 cells, probably chlamydospores (intercalary chlamydospores also occur) and conidia, 1.5μ in diameter, either singly or in groups. The radial surface runners spread centripetally, and are apparently important in determining the shape of the pits and gyrate lesions, while the deep rooting hyphae penetrate as far as the prickle cell layer, open up the lymphatic spaces, and give rise to vesicles. The fungus appears to have a marked lytic action on the horny layer of the epidermis.

On Norris agar, colonies in 4 days are small, pink, raised, gradually becoming deeper in color; finally flat, dark, and moist. Aerobic. No acid or gas on any sugar tried, profuse growth on glucose and glycerol. Litmus milk was turned slightly acid, with the appearance of a pink ring at the surface; slightly clotted with a musty odor.

Actinomyces plurichromogenus (Caminiti) Dodge, n. comb.

Streptothrix polychromogène Vallée, Ann. Inst. Pasteur **17**: 288-292, 1903.

Streptothrix pluricromogena Caminiti, Centralbl. Bakt. I, **44**: 198, 1907.

Isolated from the blood of a horse, dead of acute *Pasteurella* infection. Not pathogenic to laboratory animals.

Hyphae branched. Organism a strict aerobe, growing at temperatures between 18° and 47° C., best at about 38° C. Gram-positive.

Colony on peptone agar salmon red, shining, irregularly folded, central button with paler radiating periphery. Similar on gelatin. Growth on potato, a pale rosy gray which becomes yellowish red or even vermilion if the tube is removed from the incubator after the colony is formed. Growth folded, granular, verrucose, and dry. In peptone broth, there forms a pellicle rose salmon or deeper in color, breaking on about the eighth day and settling as a viscous ball; medium clear, but slightly colored by pigment dissolved from the pellicle. Growth similar on milk, no coagulation. On sucrose with potassium phosphate, growth colorless, and a variety of abnormal forms appear. Glycerol added to media produced yellow to orange colonies. Gelatin not liquefied.

Actinomyces micetomae Greco, Origine des Tumeurs . . . 759-771, 1916.

Streptothrix micetomae Argentinae β, Greco apud Durante, Segunda Observación de Pié de Madura o Micetoma en la República Argentina. Tesis, Buenos Aires, 1911 [reprinted by Greco, 1916].

Oospora micetomae Sartory, Champ. Paras. Homme Anim. 783, 1923.

Isolated from a case of mycetoma pedis. Organism not pathogenic to rabbits and guinea pigs.

Mycelium 0.5-1μ, not septate, branched. Gram-positive, not acid-fast.

Obligate aerobe, growth good at 30°-36° C.

On 4% glucose agar, colonies grayish white, adherent, after a month becoming brick red, cerebriform, margins of radiating hyphae. On Sabouraud agar, colony as in glucose agar but color brighter. On simple agar, colonies less well developed, less cerebriform, yellowish grayish. On potato and carrot, little growth, moist, color as on simple agar finally with white efflorescence. In broth no growth; on a decoction from 100 gm. meat, 4 gm. glycerol, water 100 gm., and potatoes at the rate of two large potatoes per liter, sterilized and filtered, or a similar broth with glucose replacing the glycerol, many small colonies appear, with cottony peripheries. No growth on milk. No growth on gelatin.

Actinomyces verrucosus (Miescher) Adler, 1904 fide Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 46, 1934.

Streptothrix verrucosa Miescher, Arch. Derm. Syphilis **124**: 314, 1917.

Isolated from mycetoma pedis with yellow grains. Medication with iodine proved ineffective, healed after application of pyrogallol—resorcin—gelante. Pathogenic to rabbit.

Mycelium 0.3-0.5μ, coiled, much branched, early fragmenting.

Aerobic, growth good on sugar media, colonies easily separable, granular, verrucose, salmon red; aerial hyphae not constant. Milk not coagulated or digested. Optimum temperature 37° C.

Hübschmann (1921) referred here a species which he had isolated from yellow grain mycetoma of the face, which was not pathogenic to experimental animals. Perhaps his organism should be referred to the group of *A. Rodellae,* since there are several discrepancies between the descriptions of Miescher and of Hübschmann. The latter described his organism as follows:

Streptothrix verrucosa? Hübschmann, Arch. Derm. Syphilis **130**: 341-352, 1921.

Mycelium in tissues 0.2-0.5μ, in cultures 0.5-0.7μ. Optimum temperature 37° C., scarcely any growth at 25° C.

Growth equally good under aerobic and anaerobic conditions. On maltose agar, colonies hemispheric, smooth, shining, transparent at first, later whitish, adherent. Red brown pigment on coagulated serum. No growth on potato or gelatin, slight growth on milk and egg. On liquid media, granular floccose sediment, liquid clear, no pellicle.

Actinomyces Sommeri Greco, Origine des Tumeurs . . . 726-758, 1916.

Streptothrix Madurae Greco, Primer Caso de Pié de Madura o Micetoma en la República Argentina, Tesis, Buenos Aires, 1904.

Streptothrix micetomae Argentinae ∝ Greco Apud Durante, Segunda Observación de Pié de Madura o Micetoma en la República Argentina, Tesis, Buenos Aires, 1911.

Oospora Sommeri Sartory, Champ. Paras. Homme Anim. 783, 784, 1923.

Isolated from a case of mycetoma pedis in Argentina. Pathogenic to guinea pigs and rabbits.

Hyphae about 1μ in diameter, occasionally up to 1.2μ; spores 2-3μ long; branching, dichotomous; spore chains helical. Gram-positive, acid-fast, aerobic.

On simple agar, colonies pale rose, hard; dry, finally light grayish rose, colonies rugose or crateriform; medium mahogany or port wine in color. On glycerol agar, colonies elevated 1-2 mm., umbilicate, rose, yellow, or orange, rose efflorescence, 3-4 times as large as on simple agar. On potato, colonies small, brick red, dry, medium not colored; on carrot, colony similar but better growth, more rose color. On serum, colonies small, grayish white, few; on gelatin, colonies small, white, poor, no growth in stab. On coagulated egg white, colonies grayish rose with white margin; on egg yolk, similar but more rose color, with a light gray granular efflorescence. In broth with peptone, pellicle light yellowish rose or gray, smooth; colonies from the lower side settling, no cloudiness, becoming mahogany colored. In lactose broth, similar, pellicle yellowish straw color. In glycerol broth, pellicle folded and granular rose color, little or no sediment. Growth in milk good, pellicle orange, milk not coagulated but slowly digested. In liver infusion, pellicle dry, more or less thick, light yellowish rose, then brick red, sediment grayish white, granular, medium not changed in color. In potato decoction, pellicle thin, fragile, white, sediment as above. In yeast infusion, no pellicle; medium remains clear but darkens.

It is possible that the following unnamed organism belongs to this species.

Streptothrix sp. Bloch, Cor. Bl. Schweiz. Aerzte **46**: 270, 271, 1916.

Isolated from a white grain mycetoma pedis. Pathogenic to rabbits, producing lesions similar to those on man.

Growth aerobic, abundant, brick red color.

Actinomyces Madurae (Vincent) Lachner-Sandoval, Über Strahlenpilze 64, 1898.

?Oospora indica Kanthack, Jour. Path. Bact. **1**: 140-162, *Pls. 10-12,* 1892 [organism seen in tissues but not cultivated].

Streptothrix Madurae Vincent, Ann. Inst. Pasteur **8**: 129-151, 1894.

Nocardia Madurae Blanchard in Bouchard, Traité Path. Gén. **2**: 868, 1896.

Discomyces Madurae Gedoelst, Champ. Paras. Homme Anim. 169-173, 1902.

Nocardia indica Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916.

Discomyces indicus Neveu-Lemaire, Précis Parasitol. Hum. 42, 1921.

Oospora Madurae Lehmann & Neumann, Atlas Grundriss Bakt. **2**: 388, 389, 1896.

Isolated from white grained Madura foot. Animal inoculations negative.

Mycelium 1-1.5μ in diameter. Arthrospores in the form of rods or spheres. Organism is aero-anaerobe but grows best anaerobically. Gram-positive, not acid-fast.

On glycerol agar, colonies very adherent to the substrate, longitudinally folded, discoid, crateriform, the periphery yellowish at first, later becoming rose or even red, the crater remaining white. Colonies on maltose peptone agar are small, discrete, yellowish white, waxy, wrinkled, becoming pinkish; the medium brownish. Colonies on potato are spherical, becoming confluent in a heaped-up, irregular, mammillate mass, creamy yellowish white to reddish, depending on the acidity of the medium, with a white efflorescence. The potato is eroded. According to Vincent there is no growth on serum. Macé claims growth similar to that on agar. No growth on egg albumen. Opaque, whitish, raised, discrete colonies on gelatin. In broth, opaque, white, floccose spheres appear at the bottom; liquid remains clear. In vegetable decoctions (15 gm. potato, hay, or straw per liter), spherical flocci on sides or bottom, liquid clear but turns somewhat brown and becomes alkaline. Milk not coagulated but peptonized after 20 days. Gelatin not liquefied.

Actinomyces bahiensis (Pirajá da Silva) Brumpt, Précis Parasitol. ed. 4, 1195, 1927.

Discomyces bahiensis Pirajá da Silva, Brasil Med. **33**: 81-83, 1919; Mem. Inst. Butantan **1**: 187-207, *Pls. 34-38*, 1918-1919.

Oospora bahiensis Sartory, Champ. Paras. Homme Anim. 784, 1923.

Isolated from yellow grain maduromycoses.

Mycelium 1-1.4μ in diameter, arthrospores observed, also deeply staining granules which the author thinks may be endospores.

Colonies on potato with whitish bloom, at first rose color then deeper red, becoming very dark in old cultures, shape of a mulberry. On yam, growth very slow, colonies rose colored, humid; on carrot, whitish, more humid, becoming light rose color and the medium finally assuming the same color. On liquid media, forming white granules which collect on the walls and bottom of the tube. No growth on maltose, glycerol, or crude sugar agar.

Actinomyces Leishmani (Chalmers & Christopherson) Sartory & Bailly, Mycoses pulmonaires 253, 1923.

Streptothrix sp. Birt & Leishman, Jour. Hyg. **2**: 120-128, *Pl. 1*, 1902.

Nocardia Leishmani Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916.

Isolated from empyema of the lungs. Pathogenic to guinea pigs, rat, and rabbit.

Ultimate branches of hyphae break up into ovoid arthrospores. Organism a strict aerobe, growing between 22° and 46.5° C., best at 37° C. Growth ceases at 50°, although five minutes at 75° C. did not kill it. Acid-fast, losing this property in old cultures, all save the arthrospores, which remain gram-positive and acid-fast.

On agar, a snow white, dry efflorescence forms, becomes delicate pale coral pink, is not adherent. On potato, with or without glycerol, there is copious dry, chalky growth, circumscribed, granular, verrucose in age; surface never wrinkled. On the third day, it assumes a coral tint which is especially evident under the efflorescence. On gelatin, small, white, circular colonies at the surface. In broth, spherical white floating colonies, the emerged portion turning a powdery pink, the remainder white and woolly. No pellicle but a slight ring which settles to the bottom. Medium clear and odorless. Milk not coagulated but digested, becoming alkaline. No growth on serum. Gelatin not liquefied.

Actinomyces carneus (Rossi-Doria) Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Streptothrix carnea Rossi-Doria, Ann. Inst. Ig. Sperim. Univ. Roma **1**: 399-438, *Pl. 8,* 1891.

Nocardia carnea Castellani & Chalmers, Man. Trop. Méd. ed. 2, 818, 1913.

Discomyces carneus Neveu-Lemaire, Précis Parasitol. Hum. 42, 1921.

Osopora carnea Sartory, Champ. Paras. Homme Anim. 810, 1923.

Originally isolated from the air. Reported by Boldoni from a case of chronic bronchitis. Pathogenic to rabbit and guinea pig, producing pseudotuberculosis. Gram-positive.

On agar, colonies small, globular, flesh or orange red in color, with rose white efflorescence. On potato, growth granular, color as on agar, but efflorescence reddish. In broth, scales at the surface, flocci at the bottom of the tube. In milk, flesh-colored growth on surface. No coagulation. Colonies on gelatin radiate with pink efflorescence, no liquefaction.

Actinomyces minutissimus (Burchard) Brumpt, Précis Parasitol. ed. 4, 1199, 1927.

Microsporon minutissimum Burchard & Bärensprung in Uhle & Wagn. Pat. Gen. 1859; Balzer, Ann. Derm. Syphiligr. II, **4**: 681-688, 1883.

Trichothecium sp. Neumann, 1868.

Microsporon gracile Balzer, Ann. Derm. Syphiligr. II, **4**: 681, 1883. [Balzer refers to this name as previously used (cf. Besnier) in France. No reference to publication.]

Sporotrichum minutissimum Saccardo, Syll. Fung. **4**: 100, 1886.

Microsporioides minutissimus Neveu-Lemaire, Précis Parasitol. 1906.

Discomyces minutissimus Verdun, Précis Parasitol. 1907.

Oospora minutissima Ridet, Oospora et Oosporoses 68, 1911.

Nocardia minutissima Verdun, Précis Parasitol. 1912; Castellani & Chalmers, Man. Trop. Méd. ed. 2, 819, 1913.

Reported as the etiologic agent of erythrasma.

Mycelium 0.6-1.3μ, rarely branched, easily dissociating into bacilliform arthrospores. Aero-anaerobe.

Micheli reports brownish growth on gelatin, wine red on agar. Ducrey reports brownish red on agar.

Actinomyces Jollyi (Vuillemin) Brumpt, Précis Parasitol. ed. 4, 1196, 1927.

Nocardia Jollyi Vuillemin apud Jolly, Rev. Méd. de l'Est **48**: 42, 43, 1920.

Oospora Jollyi Sartory, Champ. Paras. Homme Anim. 770, 1923.

Isolated from a case clinically resembling bubonic plague in which the author was unable to demonstrate the plague bacillus.

Hyphae 0.2-0.4μ in diameter. No spores seen. Organism aerobic, optimum temperature 37° C. Gram-negative, acid-fast.

Colonies on Sabouraud agar, potato glycerol, and carrot are white, delicate, velvety with deeper growth a compact, fleshy mass which erupts smooth, salmon-colored mounds through the velvet. Growth on gelatin very slow. No liquefaction.

Actinomyces Freeri (Musgrave & Clegg) Bergey, Man. Det. Bacteriol. 346, 1923.

Streptothrix Freeri Musgrave & Clegg, Philippine Jour. Sci. B. **2**: 477-511, *Pls. 1-4,* 1907.

Discomyces Freeri Neveu-Lemaire, Précis Parasitol. Hum. 42, 1921. [By Clegg & Hobdy, 1915, said to be a synonym of *Streptothrix Eppingeri* Claypole?]

Oospora Freeri Sartory, Champ. Paras. Homme Anim. 785, 786, 1923 [Castellani & Chalmers, Man. Trop. Med. ed. 3, 1058, 1919, give this as a synonym of *Nocardia Asteroides*, also Pollacci & Nannizzi, I Miceti Pat. **6**: No. 52, 1927].

Isolated from a case of mycetoma. Pathogenic to monkeys, dogs, and guinea pigs. Hyphae branching, club forms in tissues; acid-fast, gram-positive. Optimum temperature 37° C.

Colonies on agar are smooth, white, glistening; on glycerol agar, elevated, sometimes umbilicate, yellowish with pink periphery. On potato, growth good, elevated, delicate pink with yellow center. Starch not hydrolyzed, milk and gelatin not digested.

Actinomyces Hofmanni Gruber, Centralbl. Bakt. **16**: 363, 1894.

Oospora Hoffmanni Sauvageau & Radais, Ann. Inst. Pasteur **6**: 251, 1892.

Micromyces Hofmanni Gruber, Trans. Int. Cong. Hyg. Derm. VI, **2**: 65, 1891 (1892); Arch. Hyg. **16**: 35-52, *Pl. 1,* 1892.

Streptothrix Hoffmanni Petri, N. Giorn. Bot. Ital. n. s. **10**: 592, 1903.

Nocardia Hoffmanni Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 268, 1916.

Isolated from a sample of vaccine. Pathogenic to mice and rabbits.

Hyphae less than 1μ in diameter, variously curved and thickened, branched, not septate. Only secondary hyphal branches break up into spores.

Occasionally tips of hyphae are swollen to five or six times hyphal diameter, probably as a degeneration phenomenon rather than for spore formation. Optimum temperature 37° C., no growth at 17°-22°, nor at 40° C. Organism aerobic. Gram-positive.

On solid media, e.g., nutrient agar with sugar, colony shows an irregularly indented contour, gray white, brownish in age—light brown by transmitted light, dark brown when opaque. Surface dull, uneven, folded regularly in radiating lines in old colonies, adherent, circumscribed, hemispheric or irregularly verrucose in appearance. No growth on gelatin or potato. Coagulated blood serum is an unsuitable medium unless sugar is added. A white, powdery deposit appears in liquid media, the medium remaining clear. Alcohol somewhat oxidized to acetic acid.

Actinomyces niger (Rossi-Doria) Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

Streptothrix chromogena Gasperini (fide Rossi-Doria).

Streptothrix nigra Rossi-Doria, Ann. Ist. Ig. Sperim. Univ. Roma N. S. **1**: 399-438, *Pl. 8,* 1891. [*cf.* Foulerton & Jones 1902.]

Nocardia nigra Castellani & Chalmers, Man. Trop. Med. ed. 2, 1913.

Isolated from air by Rossi-Doria.

Colony white, substrate blackened on sugar media. Colonies on egg white remain humid, not becoming powdery. Milk is coagulated and digested in about 10 days, becoming yellowish red and then brown. No acid produced.

Actinomyces lingualis (Weibel) A. Sartory & A. Bailly, Mycoses Pulmonaires 252, 1923.

Vibrio lingualis Weibel, 1888.

Spirosoma lingualis Migula, 1892.

Streptothrix lingualis Bajardi, Centralbl. Bakt. I, **36**: 129-137, *1 pl.,* 1900.

Found in mouth. Of doubtful pathogenicity to guinea pig.

On a gelatin plate, after 12-24 hours at 18° C., small punctiform colonies appear throughout the whole medium. On magnification, these colonies appear yellowish with irregular margins from which project branched hyphae. On agar plate, growth similar except that individual isolated branches rarely project from the colonies into the medium. On gelatin stab, surface growth elevated, round, with center depressed, not spreading far from point of inoculation. Margins wavy. Along stab, short dendritic projections with clavate ends perpendicular to line of stab, the length of these projections decreasing with distance from the surface, giving appearance of a test tube brush. Growth on agar stab somewhat similar except that colony is more extended, with fine wavy margins and small elevations on the surface which appear to be due to overlapping colonies. Color dirty white, gradually becoming yellowish. Along the stab a band with finely lobate margins. Streak culture on agar slant shows a dirty white covering with surface at first moist, later dry, not developing far from the line of inoculation. In older cultures, appearance finely verrucose and canary yellow in color. Warts like pinheads with rounded, projecting points. If the streak is so made that the colonies do not become confluent, they give the typical mammillate appearance. On potato, growth is slow and limited, growth only detectable by dampness of the surface of the potato. Later a dry, linear growth with even margins. In broth, at first a slight cloudiness with small amount of pulverulent deposit, medium later clearing with a granular sediment, granules becoming flocculent in old cultures. In 10-day-old broth cultures, there is a tendency to pellicle formation with a fragmentary surface covering. In any case, a ring forms with a dirty white color, later turning yellowish, easily broken up. No indol formation. No fermentation with any sugars. Milk not coagulated, gelatin gradually liquefied.

Organism grows between 18° and 42° C., optimum temperature being 37° C.

Actinomyces phenotolerans C. H. Werkman in Gammel, Arch. Derm. Syphilol. **29**: 286-297, 1934.

Isolated from granuloma in man. Pathogenic for guinea pigs when inoculated into the lungs.

Mycelium straight with lateral branching, less than 1μ in diameter, chains of conidia abundant, prostrate, racemose type without helices, very acid-fast, hyphae gram-positive, spores gram-negative.

On Krainsky's glucose agar, colonies small, round, adherent to medium; surface powdery, white to grayish white, becoming orange in old cultures; no odor, medium not discolored. On potato, colonies small, chalky, confluent into orange membrane with odor of market garden soil. On gelatin, white surface growth with very slow liquefaction. On serum, cream colored surface growth with arborization. In Dunham peptone broth, an abundant flaky sediment. Good growth in broth with 0.5 per cent phenol. On sugar broths, growth good with most sugars, sediment flaky with solution becoming alkaline. Litmus broth becomes alkaline with surface growth. No amylase on starch agar. Nitrates reduced to nitrites, no tyrosinase, no soluble pigment. Aerobic, optimum temperature 37° C.

Actinomyces Bellisari, Dodge, n. nom.

Streptothrix alba Bellisari, Ann. Ig. Sperim. **14**: 467-483, 1904.

Oospora alba Sartory, Champ. Paras. Homme Anim. 819, 1923.

Isolated in a warehouse in Naples from the dust of cereal coming from California. Pathogenic to rabbits.

On agar, colonies amber yellow, very small, not confluent, spores producing a whitish efflorescence which seems limited to the periphery. On potato, growth thick and folded, white, after a week with brownish fissures. No diffusion of color into the medium. On gelatin stab, small white granules appear. These are larger near the surface where the growth expands gradually into a folded white pellicle covering the surface. In broth, colonies small, spherical, isolated, settling and leaving the medium clear. Gelatin slowly liquefied, liquefaction beginning about the twentieth day.

Actinomyces convolutus (Chalmers & Christopherson) Brumpt, Précis Parasitol. ed. 4, 1195, 1927.

Nocardia convoluta Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 223-282, *Pls. 8-11,* 1916.

Discomyces convolutus Neveu-Lemaire, Précis Parasitol. Hum. 44, 1921.

Oospora convoluta Sartory, Champ. Paras. Homme Anim. 769, 1923.

Isolated from a yellow grain mycetoma in the Sudan. Not pathogenic for monkeys or other laboratory animals.

Mycelium less than 1μ in diameter. Spores in chains, spherical, 1μ in diameter. No claviform formations. Organism an aero-anaerobe. Gram-positive, not acid-fast. Optimum temperature 30° C., fair growth anywhere between 22° and 37° C.

Colonies warm buff (Ridgway) before the white efflorescence appears, convoluted, not pigmenting agar media. Growth best on alkaline media. Colony on Sabouraud maltose agar more radiate than convoluted. On potato, good development, convoluted, moist, warm buff with an efflorescence. Colonies on gelatin light buff, small, round; medium not pigmented. Similar on serum. White efflorescence on milk; medium not coagulated or digested but is made slightly more alkaline. In peptone broth with glucose, white, noncohering flocci are deposited, with liquid remaining clear. No acid or gas with glucose, maltose, lactose, sucrose, raffinose, mannitol, or salicin. Serum liquefied. Gelatin not liquefied.

Actinomyces serratus (Sartory, Meyer & Meyer) Dodge, n. comb.

Actinomyces asteroides var. *serratus* Sartory, Meyer & Meyer, Ann. Inst. Pasteur **44**: 298-309, 1930. (See also C. R. Acad. Sci. **188**: 745-747, 1929.)

Isolated from a case of actinomycosis of bones with yellow grains. Pathogenic for guinea pigs, but no bone lesions obtained, not even with dog.

Filaments fragile, branched, segmenting easily, 0.3-0.6μ in diameter. Arthrospores 1μ in diameter. Gram-positive, spores acid-fast.

On agar, colonies whitish, verrucose, becoming ochraceous in age, confluent into a folded pellicle. On potato, colonies mammillate, whitish, lumpy, becoming powdery, yellowish gray. Serum not liquefied, milk not coagulated but slowly digested. Gelatin not liquefied, no growth in depths.

Cultural characters suggest *A. convolutus* Chalmers & Christopherson, but this organism differs in action on serum.

Actinomyces Donnae Dodge, n. sp.

Streptothrix sp. Donna, Ann. Ig. Sperim. **14**: 449-459, *Pl. 3,* 1904.

Isolated from sputum in a pulmonary infection. Pathogenic to rabbits.

Organism aerobic. Colonies small, 2 mm. in diameter, opaque, yellowish white. Growth less on gelatin. In beef broth, there is turbidity with floccose sediment and some evolution of gas. Liquid finally clears. At lower temperature there is no turbidity, and broth remains alkaline. Gelatin not liquefied.

Actinomyces deBerardinis Namsłowsky, Centralbl. Bakt. I, **62**: 566, 1912.

Streptothrix sp. Berardinis, Ann. Ottalmol. Lavori Clin. Oculist. Napoli **33**: 914-924, *1 pl.*, 1904.

Isolated from a case of conjunctivitis. Following accidental inoculation of the eye, corneal ulcers were produced. Organism pathogenic to rabbits.

Long spore chains formed.

On agar, there is a delicate yellow growth. On potato, colony is elevated in the center with margin undulate and reddish. Small, yellowish white colonies on gelatin. Broth becomes uniformly turbid and of a delicate yellow color, eventually turning brownish. Only moderate growth in glycerol broth, better with glucose or lactose added. Growth good on rabbit serum, poor on milk. Gelatin not liquefied.

This organism is close to *A. Gruberi* or *A. asteroides (S. Eppingeri).*

Actinomyces farcinicus (Trevisan) Gasperini, Ann. Ist. Ig. Sperim. Univ. Roma **2**: 2, 1892.

Bacillus du farcin Nocard, Ann. Inst. Pasteur **2**: 293-302, *Pls. 7, 8,* 1888.

Nocardia farcinica Trevisan, I Genere e Species delle Batteriacee 9, 1889.

Streptothrix farcinica Rossi-Doria, Ann. Ist. Ig. Sperim. Univ. Roma. N. S. **1**: 404, 1891.

Oospora farcinica Sauvageau & Radais, Ann. Inst. Pasteur **6**: 248, 1892.

Actinomyces bovis farcinicus Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Streptothrix Nocardii Foulerton & Jones, Trans. Path. Soc. London **53**: 57, 97, 98, 1902.

Discomyces farcinicus Gedoelst, Champ. Paras. Homme Anim. 167-169, 1902.

Nocardia albida Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 271, 1916.

Found in farcy of oxen. Pathogenic for guinea pig, ox, and sheep, not very pathogenic for rabbit, goat, dog, cat, horse, or ass.

Hyphae long, branched, 0.25μ in diameter. Arthrospores cylindrical, 2μ long. Organism a strict aerobe. Gram-positive, acid-fast.

On maltose peptone agar, colonies opaque, dull, granular, circular, flat, becoming confluent and mammillate, yellowish white with a white efflorescence of arthrospores. Colonies on potato dry, grayish buff to yellow, granular, confluent into a folded or verrucose pellicle with white efflorescence, margins elevated. On serum, growth is slower and humid, otherwise as on agar. On gelatin, growth slow, slightly elevated, medium brownish when acid. In peptone beef broth, whitish irregular flocculent masses appear at the bottom with scales on the surface, resembling drops of fat (especially on glycerol broth). Similar in litmus milk. No alteration in medium or coagulation. Serum not liquefied. Gelatin liquefied.

Actinomyces japonicus Caminiti, Centralbl. Bakt. I, **44**: 198, 1907.

Streptothrix sp. Aoyama & Miyamoto, Mitteil, Med. Fak. K. Jap. Univ. Tokio **4**: 231-276, *Pls. 16-18,* 1901.

Cultivated from the pus in a fatal infection of the lungs. The sputum was too contaminated with bacteria to permit of easy isolation of the fungus. Pathogenic to guinea pigs. Authors finally decided the infection was a mixture of tuberculosis and actinomycosis.

Terminal portions of the hyphae coiled. Aerobic. Gram-positive.

Colonies star-shaped, white at first, yellowing and elevated in age, size of lentil, surface rough, center darker, opaque, yellowish, dry. On potato, chalky white granules, confluent, center of colony brownish yellow with chalky white efflorescence, finally brownish. Also grow well on *Colocasia antiquorum, Nelumbium setosum,* carrot, and *Dioscorea japonica,* on the first and last substrate not adherent. On blood serum, growth not rapid, colonies yellowish and flat. On broth gelatin, growth poor. On broth and Piorkowsky urine-peptone, small gray white or chalk white nodules, often confluent, settling to the bottom, no turbidity, never yellowish in color. Surface of milk yellows in 2 days, milk not coagulated or digested.

Actinomyces pretorianus (Pijper & Pullinger) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4:** 38, 1934.

Nocardia pretoriana Pijper & Pullinger, Jour. Trop. Med. Hyg. **30:** 153-156, *2 pls.,* 1927.

Isolated from a mycetoma of the shoulder showing yellow grains, 0.5 mm. in diameter, possessing clavate bodies. Pathogenic to guinea pig.

Hyphae long, 0.5μ in diameter, showing marked branching. Organism a strict aerobe, growth best at 37° C., but possible at 22° C.

Growth circumscribed, in general tending toward orange in pigmentation, no efflorescence, no pigmentation of the medium, adherent. No diastase present. No growth on Sabouraud agar. On potato and simple agar, growth largely buff and elevated, in parts convoluted and orange. Better growth when glycerol is added. Growth on carrot convoluted, orange; on blood agar, buff. On gelatin or blood serum, growth poor, white to orange. In simple broth, glycerol broth, or sugar broth, thick, convoluted, bright orange pellicle forms. In hay extract, gray surface films showing small round tufts and a radial structure. Surface of litmus milk is orange, convoluted. No acid or fermentation with any of the usual sugars. Milk coagulated after 10 days. No liquefaction of gelatin or coagulated serum.

Actinomyces macrodipodidarum (Fox) Dodge, n. comb.

Nocardia macrodipodidarum Fox, Disease in Captive Wild Mammals and Birds, 570-595, 1923.

Found in lumpy jaw with septicemia and gasteroenteritis of kangaroos. Inoculations into experimental animals negative.

Hyphae up to 1μ in diameter. Gram-positive.

On blood serum, colonies opaque, pale yellow, circular, discrete, slightly depressed, irregular; no umbilication in center; smooth and slightly glistening for several days, then wrinkled and twisted. Growth on potato is dirty yellow, much wrinkled, friable, adherent. A tough wrinkled scum forms on the surface of gelatin. Litmus milk shows no change in 6 days, then slight alkalinity with thin pellicle on surface; caseinogen digested. In broth, surface growth only as a wrinkled, pale yellow pellicle with faint turbidity in medium. No action on sugars.

Actinomyces canis (Rabe) Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Cladothrix canis Rabe, Berlin. Tierärztl. Woch. 1888.

Oospora canis Sartory, Champ. Paras. Homme Anim. 821, 1923.

Streptothrix caprae Silberschmidt (1899), referred here by Chalmers & Christopherson.

Pathogenic for rabbit and guinea pig (subcutaneous and intravenous injections produce tubercles with giant cells, rapidly becoming cheesy).

Acid-fast, aero-anaerobic.

Agar colony dry, verrucose, yellowish white with white efflorescence; some colonies crateriform. On potato, small whitish colonies which become rose brown after a while; isolated colonies round, dry, crateriform. Colony on gelatin, brownish at the center, clear at the periphery, formed of very slender radiating filaments. In broth, concave dry discs on surface, whitish, small, farinose; slight deposit, liquid clear. On milk, pink pellicle at the surface, no coagulation.

Actinomyces caprae (Silberschmidt) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 50, 1934.

Streptothrix caprae Silberschmidt, Ann. Inst. Pasteur **13**: 841-853, 1899.

Discomyces caprae Gedoelst, Champ. Paras. Homme Anim. 174-176, 1902.

Oospora caprae Sartory, Champ. Paras. Homme Anim. 813, 814, 1923.

Referred to *A. canis* by Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916.

Found in the lungs of a goat in Switzerland. Pathogenic to rabbit and guinea pig.

Aerobic. Optimum temperature 33°-37° C.

On 4% glycerol agar, colony dry, verrucose, shrivelled, surface brownish white with a raised, irregular, brownish white farinose center, flattened to subcrateriform. On Loeffler's serum, growth good, similar. On maltose peptone agar, at 37°, spreading drab color with dull efflorescence; medium darkening in age. On potato, colony small, whitish then rose brown, round, dry, sometimes crateriform, with a white efflorescence, finely granular, medium browned. On gelatin, colonies deep brown at center, lighter at margin, becoming chalky white (spore formation); reverse pink, wrinkled. In peptone beef broth or sugared broth (2%), colonies are concave discs on surface, dry, whitish, powdery, forming pellicle by coalescing, not readily sinking. Slight grumous deposit. Medium clear. On milk, rose white pellicle, no coagulation, no change in pH (litmus). Neither gelatin nor serum liquefied.

Actinomyces bicolor Trolldenier, Zeitschr. Tiermedizin **7**: 81-109, *9 figs.*, 1903.

Nocardia bicolor Froilano de Mello & St. Antonio Fernandes, Mem. Asiatic Soc. Bengal **7**: 106, 1919.

Found in cerebromeningitis, bronchitis, and lymphadenitis in dog. Pathogenic to white mice, guinea pigs, rabbits, dog, with infection easy. Horse, calf, and birds infected with difficulty, cats not at all.

On agar, glycerol peptone, or albumose, colonies white at first, then yellow at the center with white margins. Whole surface wavy and crateriform, crater elevated 3 mm. On potato, growth is in the form of white granules, either discrete or confluent, showing small, grayish white heads on rough spinulose surface; center finally becomes yellow gray; sweet odor developed. On gelatin, colonies white, becoming dirty yellow after several weeks, with the upper layer of the gelatin yellowed. Colonies smaller on coagulated horse serum. In liquid horse serum, small white colonies on the surface, forming a granular pellicle, and at the bottom, woolly, discrete balls. In alkaline broth, the medium remains clear, bottom growth as in serum. Surface growth shows discrete colonies with center yellow and margin white, suggesting a floating composite flower with white ray flowers. Neither coagulated horse serum nor gelatin liquefied.

It is possible that the following unnamed species belongs here.

Streptothrix sp. Horst, Zeitschr. Heilk. Abt. Prakt. Anat. **24**: 157-176, *Pls. 13, 14,* 1903.

Isolated from patient with pyemia and brain and bronchial abscesses. Pathogenic to mice, guinea pigs, and rabbits.

Helices on potato. No clavate forms in tissues. Organism gram-positive and acid-fast.

Colonies white, powdery, becoming gray, slightly shining, 2-3 mm. in diameter. On glycerol agar, growth is thick, folded, moist; the efflorescence whitish, becoming yellowish, and then reddish with white margin. On serum agar, small granular colonies appear. Colony on potato thick, white, dry, fine-grained, becoming thick, wrinkled, and finally brown. Growth on beet similar. On gelatin, thin, fine, granular, dry colonies. In broth, small white granules from a very thin, fragile pellicle, also small floating colonies in the depths, but no turbidity. Growth much less in sugar broth, and poor in peptone solution. Organism grows on milk as a thick sulphur yellow, later orange, pellicle, without altering the medium. Gelatin not liquefied.

Actinomyces brasiliensis (Lindenberg) Gomes, Ann. Palistas Med. Cirurg. **14**: 150-156, 1923.

Discomyces brasiliensis Lindenberg, Rev. Méd. São Paulo Sept. 30, 1909; Arch. de Parasitol. **13**: 265-282, *3 figs.,* 1909.

Nocardia brasiliensis, Castellani & Chalmers, Man. Trop. Méd. ed. 2, 816, 1913.

Streptothrix brasiliensis Greco, Origine des Tumeurs . . . 724, 1916.

Oospora brasiliensis Sartory, Champ. Paras. Homme Anim. 786, 1923.

Isolated from a mycetoma of the thigh and leg (10 cm. below inguinal fold to upper portion of the foot with movement of the knee inhibited), Brazil. Not inoculable to ordinary laboratory animals.

Hyphae 0.5μ in diameter, spores 1-2μ in diameter, spherical to ovoid. Optimum growth at room temperature [tropical]. Aerobic.

Colonies on ordinary agar opaque, chalky white to yellow, being white at the center and orange ochraceous at the margin, showing concentric zoning. Colonies on Sabouraud agar at 37° C., rose violet. On Sabouraud glucose, growth poorer than on ordinary agar, white at room temperature, rose violet at 37° C. On potato as on agar, orange yellow with radiating furrows; medium colored brown. Colony on serum, whitish at 37°, yellowish at room temperature. Good growth on egg. Milk shows an orange yellow growth, pellicle on surface, no coagulation. Slight growth on broth at 37°, hay infusion shows filamentous flocci. Gelatin not liquefied.

Chalmers & Christopherson relegate this species to *Actinomyces asteroides,* but it differs in the nature of the grain (soft in *A. brasiliensis*) and the colony on Sabouraud agar here is wholly rose violet, while that of *A. asteroides* is yellow at the center and red at the periphery on this medium.

Castellani & Chalmers, Man. Trop. Méd. ed. 3, 1058, 1919, also give this as synonym of *Nocardia asteroides,* as do also Neveu-Lemaire, and Pollacci & Nannizzi.

Actinomyces asteroides (Eppinger) Gasperini, Centralbl. Bakt. I, **15**: 84, 1894.

Cladothrix asteroides Eppinger, Wiener Klin. Woch. **3**: 321-323, 1890; Beitr. Path. Anat. [Ziegler] **9**: 287-328, *Pls. 13, 14,* 1891.

Streptothrix asteroides Gasperini, 1891; Petri. N. Giorn. Bot. Ital. n. s. **10**: 591, 1903.

Streptothrix Eppingeri Rossi-Doria, Ann. Ist. Ig. Sperim. Univ. Roma. N. S. **1**: 399-438, *Pl. 8,* 1891.

Oospora asteroides Sauvageau & Radais, Ann. Inst. Pasteur **6**: 250, 1892.

Nocardia asteroides Blanchard, in Bouchard, Traité Path. Gén. **2**: 811-926, 1895.

Discomyces asteroides Gedoelst, Champ. Paras. Homme Anim. 173, 174, 1902.

Streptothrix Freeri Musgrave & Clegg, Philippine Jour. Sci. B. **2**: 447-511, 1907, was referred here by Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916.

This organism is an aerobe (Foulerton-Jones), aero-anaerobe (Chalmers & Christopherson), or anaerobe (Castellani) found in mycetoma (Castellani) in brain abscess from a case of meningitis, and in diffuse peritonitis (MacCallum). The original case was pseudotuberculosis with cerebrospinal meningitis. Pathogenic to rabbits, guinea pigs, and monkeys with pseudotuberculosis following intraperitoneal inoculation. Cultures soon lose their virulence. Rossi-Doria found them nonpathogenic.

Mycelium 0.2μ in diameter, spores nearly spherical and in chains.

On agar, colonies verrucose, becoming confluent and crateriform or irregularly folded, pale yellow becoming ochraceous in age, 3-4 mm. in diameter, adherent. Colonies similar on glucose or glycerol agar, but growth is more rapid. On potato, colonies are elevated and verrucose, white at first, then brick red, color darker at the center, then covered with a white conidial efflorescence. On gelatin and serum, culture yellow, raised and wrinkled, no pigmentation of the medium. In peptone beef broth, liquid remains clear with a sediment of small, very thin scales at the bottom of the tube, and a thin waxy, fragile pellicle. Litmus milk is at first acidified, then becomes alkaline with the formation of a yellowish granular sediment. Litmus whey decolorized, with the formation of a thick pellicle and sediment. In a mixture of agar and hydrocele fluid, growth is thick, homogeneous, with a yellowish white film over the whole surface. Milk not coagulated. Gelatin and coagulated serum not liquefied.

Actinomyces Sanfelicei (Redaelli) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 51, 1934.

Nocardia Sanfelicei Redaelli, Ist. Sieroterapico Milanese **7**: 75-101, 121-135, *Pls. 1-8,* 1928.

Streptothrix acido-resistente Sanfelice, Boll. Ist. Sieroterapico Milanese **2**: 327-331, 1922.

Isolated from fatal lesions in rat; source unknown. Pathogenic to guinea pig, rabbit, rat, etc.

Growth at temperatures between 15° and 40° C., optimum 37° C. Aerobic, gram-positive, usually acid-fast.

Growth on solid media best in those containing glycerol, colony semitransparent, margins irregular, surface minutely verrucose, becoming thick rugose, yellowish, not adherent. On carrot agar, colonies round, elevated, folded to cerebriform. On Petragni & Petroff medium, development is more abundant, with thick, yellowish, finely mammillate colonies, margins thin, smooth, semitransparent, festooned. On potato as on agar. Colonies on potato glycerol yellowish red, thick, irregularly rugose, very adherent. On liquid media, thin grayish pellicle becoming thick, yellowish, and rugose; small, hard, granular colonies in sediment. No fermentation of sugars, no liquefaction of gelatin, no coagulation of milk. Slight acidity on sugar broths (except lactose).

Actinomyces spumalis (Sartory) Dodge, n. comb.

Oospora spumalis Sartory in Sartory & Bailly, Mycoses pulmonaires 318-321, 1923.

Isolated from sputum. Patient recovered under iodide treatment. Pathogenic to guinea pig.

Growth at 37°. Mycelium 0.4-0.5μ in diameter, irregularly branched. Terminal chlamydospores, often in chains, 0.8μ in diameter. Helices of 4-5 turns abundant in older cultures.

Growth good on carrot and maltose. Gelatin not liquefied, but a red pigment rapidly diffuses into the gelatin. No growth on Raulin's neutral medium, coagulated serum, egg albumen, potato, or potato-glycerol.

Perhaps the following variety of Sartory is a synonym.

Oospora pulmonalis var. *chromogène* Sartory, C. R. Soc. Biol. **74**: 166-168, 1913.

Isolated from sputum of a patient suspected of having pulmonary tuberculosis. Pathogenic to guinea pig.

Mycelium branched, spores 0.8μ in diameter.

On maltose agar, colonies 1 cm. in diameter, white to cream white. On maltose gelatin, colony punctiform, red pigment diffusing into the medium, no liquefaction. No growth on Raulin's neutral medium, coagulated serum, egg albumen, or potato.

Actinomyces flavus (Chester) Dodge, n. comb.

Actinomyces sp. Bruns, Centralbl. Bakt. **26**: 11-15, 1899.

Streptothrix flava Chester, Man. Det. Bact. 362, 1901.

Nocardia Bruni Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 256, 1916.

Actinomyces Bruni Brumpt, Précis Parasitol. ed. 4, 1204, 1927.

Isolated from pus from a case of actinomycosis of the abdominal wall. Nonpathogenic to laboratory animals.

Hyphae 1-3μ in diameter, up to 100μ or more long, with swollen tips. Gram-positive, aero-anaerobic; optimum temperature 35°-38° C., no growth below 25° C.

Colonies on agar yellowish, surface irregular, subcerebriform, adherent. Very slight development on potato. In broth, fragile, yellowish white scales in sediment, medium clear, no pellicle. Growth much slower under aerobic conditions. Gelatin not liquefied.

Actinomyces Spitzi (Lignières & Spitz) Dodge, n. comb.

Streptothrix Spitzi Lignières & Spitz, Arch. de Parasitol. **7**: 428, 1903.

Oospora Spitzi Sartory, Champ. Paras. Homme Anim. 775, 776, 1923.

Found in mycosis of the upper jaw in oxen in Cordoba Province, Argentina. Pathogenic to oxen and sheep; less so to horse and pig; not pathogenic to the usual laboratory animals.

In pus, small grains, 40-50μ in diameter, composed of young, radiating hyphae. Medium-sized grains 50-100μ in diameter. Hyphae more branched, with pyriform swellings up to 2μ in diameter and with mucous secretion. The very large grains, up to 2 mm. in diameter, are formed of agglomerations of medium-sized granules and are firm and grayish or yellowish in color. These degenerate with deposit of calcium. The outer layer is composed of clavate forms, 3-4 × 15-20μ. This organism is a facultative aerobe, with growth at 37° C. only when first isolated. In young cultures, hyphae bacilliform, straight, or slightly curved. Gram-positive.

Growth under aerobic conditions as follows: On agar, growth slow. Large colonies, white, opaque, circular, with the center elevated in the shape of a hemisphere and the marginal zone flat. The small colonies are more irregular, not adherent but penetrating the substrate, some becoming crateriform; aerobic subcultures rapidly dying. Growth similar on coagulated serum. Usually no growth on potato, but occasionally small, grayish white colonies of gram-positive filaments. No growth on potato-glycerol. In broth, there appear grayish white, fine grains, slightly adherent to the walls of the tube, and an abundant floccose deposit; the medium remains clear. In serum broth, growth better but otherwise the same. No growth on gelatin at 22° C. At 37° C., growth as in broth. In hay infusion, growth as in broth. Milk is coagulated slowly, with the whey becoming acid. Curd not digested. Neither coagulated serum nor gelatin liquefied. No indol formation.

Anaerobic cultures show some variations. On agar, colonies round, elevated, shining, moist, whitish, 2-3 mm. in diameter, not adherent, no efflorescence, odor of hydrogen sulphide. No growth on potato. Growth on gelatin and broth as in aerobic, except that with the latter there is also produced the odor of hydrogen sulphide.

Actinomyces cruoris (Macfie & Ingram) Brumpt, Précis Parasitol. ed. 4, 1195, 1927.

Nocardia cruoris Macfie & Ingram, Ann. Trop. Med. Parasitol. **15**: 283-285, 1921.

Oospora cruoris Sartory, Champ. Paras. Homme Anim. 809, 1923.

Isolated from the heart blood of a patient, both of whose lungs were affected with a bronchopneumonia and whose case had otherwise presented the clinical picture of encephalitis lethargica. Necropsy findings given in detail. Pathogenicity not proved. Guinea pigs not affected after 7 months.

Hyphae freely branching, nonseptate, 1μ or less in diameter, in old cultures fragmenting with ends of branches clavate.

No growth on glucose or maltose agar. Growth on blood agar or *"nas agar"* at 26° or 37° C., slowly spreading, smooth and dome-shaped, later opaque and puckered in the middle, radially striate and semitransparent at the periphery. In early cultures, the efflorescence is abundant and blue. In later subcultures, it is scanty and gray or white, medium not pigmented. Growth slow and feeble under anaerobic conditions. Cultures have no distinctive odor. On potato, growth is abundant, whitish, developing a brown or gray brown efflorescence and staining medium dark brown. Growth also good on coagulated blood serum with substrate also being pigmented dark brown. No growth on gelatin, broth, or peptone water. No change in arabinose, rhamnose (isodulcite), galactose, glucose, fructose, mannose, lactose, maltose, sucrose, raffinose. starch, dextrin, glycogen, inulin, amygdalin, helicin, phlorhizin, salicin, glycerol, erythritol, adonitol, dulcitol, inosite, mannitol, sorbitol. Litmus milk unchanged. Coagulated serum not liquefied.

Actinomyces africanus (Pijper & Pullinger) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 8, 1934.

Nocardia africana Pijper & Pullinger, Jour. Trop. Med. Hyg. **30**: 153-156, *2 pls.*, 1927.

Isolated in a case of mycetoma pedis involving bones. Grains carmine red, ¼ to ½ mm. [micron in original description. Error?] in diameter. No clubs, no sheaths. Foot was amputated. Pathogenic to guinea pig.

This organism appears to be a strict aerobe, is gram-positive, but not acid-fast. No odor. No growth at 21° C.

No growth on Sabouraud agar, broth agar, potato, glycerol potato, coagulated serum, gelatin, glycerol broth, carrot sugar broth, hay infusion. Organism is hemolytic, growing on blood agar with the formation of red colonies. In milk, bright red grains similar to those in lesions and soft curd formed. No change in reaction of the milk. Some colonies 2-3 mm. in diameter. When whey is separated from curd, organism grows with white colonies in the whey and red on the clot. There is good growth, bright orange in color, on transverse sections of maize cobs. Appearance on solid egg medium is the same. No growth on tyrosine-free media, the red pigment being dependent on the presence of tyrosine in acid solution, optimum pH being 5. No decolorization of pigment once formed nor transition to melanin. The color may be partially extracted with ether, leaving colorless colonies which again become red on the addition of acid.

Actinomyces Berestneffi (Chalmers & Christopherson) Sartory & Bailly, Mycoses pulmonaires 256, 1923.

Nocardia Berestneffi Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 1916.

Streptothrix cas I, II Berestnev, Inaug. Diss. Moskva, 1897.

Organism is both aerobic and anaerobic, grows on serum, not on gelatin or potato.

Actinomyces Ponceti Brumpt, Précis Parasitol. ed. 4, 1205, 1927.

Nocardia Ponceti Verdun, Précis Parasitol. 1912; Castellani & Chalmers, Man. Trop. Med. ed. 3, 1060, 1919.

Discomyces Ponceti Neveu-Lemaire, Précis Parasitol. Hum. 43, 1921.

Oospora Ponceti Sartory, Champ. Paras. Homme Anim. 778, 1923.

Said to be a synonym of *A. Krausei* Chester (1901) by Chalmers & Archibald, N. Orleans Med. Surg. Jour. **70**: 465, 1918; recognized by Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 133-206, 1918, and by Castellani & Chalmers, Man. Trop. Med. ed. 3, 1060, 1919.

Isolated by Morhof, Door & Poncet from a muscular pseudo-actinomycosis.

Bacilliform elements appear on serum in 24 hours.

No growth on agar, gelatin, carrot, potato, or oatmeal. Broth turbid with fine flakes at the bottom of the tube.

Actinomyces buccalis (Roger, Bory & Sartory) A. Sartory & A. Bailly, Mycoses pulmonaires 256, 1923.

Oospora buccalis Roger, Bory & Sartory, Bull. Mém. Soc. Méd. Hôp. Paris **27**: 319, 326, 1909; C. R. Soc. Biol. **66**: 301-303, 1909.

Discomyces buccalis Brumpt, Précis Parasitol. 1910, not *Streptothrix buccalis* Goadby, 1903.

Nocardia buccalis Castellani & Chalmers, Man. Trop. Med. ed. 2, 819, 1913.

Found in a case of creamy stomatitis with tonsillar abscess. Caused generalized pseudotuberculosis in guinea pigs.

Hyphae 0.7-0.8μ in diameter, branching, forming irregular spores in long undulating chains. Spores at first barrel-shaped, then ovoid.

Growth good on maltose broth, or broth with glycerol or glucose. On carrot, small white protuberances form, 0.8-2 mm. in diameter. No growth on potato or Jerusalem artichoke. Growth very poor on gelatin or maltose agar, with small, punctiform colonies, 0.5 mm. in diameter, slightly depressed in the center.

Perhaps the following unnamed species is closely related.

Actinomyces sp. A. Sartory & R. Sartory, Bull. Acad. Méd. III, **94**: 893, 894, 1925.

Isolated from patient with bronchitis. Pathogenic to rabbit and guinea pig.

Hyphae 0.4-0.5μ in diameter, variable in length, some branches coiling about three turns, other branches giving rise to chains of arthrospores, 0.5-0.6μ in diameter.

No growth on potato, Jerusalem artichoke, agar, or gelatin. Good growth on carrot and banana.

Further publication promised.

Actinomyces Krausei (Chester) Brumpt, Précis Parasitol. ed. 4, 1204, 1927.

Streptothrix sp. Krause, Centralbl. Bact. **26**: 209, 1899.

Streptothrix Krausei Chester, Man. Det. Bact. 364, 1901.

Nocardia Krausei Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 263, 1916.

Isolated from the pus of an abscess on the lower jaw. Pathogenic to guinea pig, rabbit, and mouse.

Hyphae composed of long and short cells suggesting *Corynebacterium*. Organism and aero-anaerobe, gram-positive. Optimum temperature 37° C., no growth at 22° C.

On glycerol agar, light yellowish colonies, 2-3 mm. in diameter, with deep, toothed margins; slow in growth, adherent, not confluent. In broth, growth rapid, no pellicle at the surface, no turbidity, spherical colonies at bottom. Claviform formations on serum. No growth on gelatin or potato. No fermentation. No formation of hydrogen sulphide or indol.

Actinomyces Pijperi (Castellani & Chalmers) A. Sartory & A. Bailly, Mycoses pulmonaires 256, 1923.

Nocardia sp. Pijper, Folia Microbiol. **5**: 50-53, *1 pl.,* 1917; Med. Jour. S. Africa **12**: 141, 142, 1917.

Nocardia Pijperi Castellani & Chalmers, Man. Trop. Med. ed. 3, 1060, 1919.

Discomyces Pijperi Neveu-Lemaire, Précis Parasitol. Hum. 44, 1921.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 811, 1923.

Found in the mucopurulent sputum of a patient with chronic bronchitis that had lasted for eleven years. Pathogenic to guinea pigs on intraperitoneal injection.

Hyphae 0.2-0.3μ in diameter, nonseptate, ends swollen, often containing granules; gram-positive, not acid-fast.

On agar, small whitish colonies which increase in size and become hard, cartilaginous crusts, yellowish, and adherent. Surface corrugated. Occasionally a small whitish growth on potato. On serum and serum agar, growth same as on agar. No growth on gelatin at 22° C. Litmus milk discolored. Broth clear, only bottom growth. Anaerobic cultures never reach a great size.

Actinomyces Sartoryi Dodge, n. sp.

Oospora pulmonalis var. *acido-resistant* Sartory, Arch. Méd. Pharm. Milit. **70**: 605-609, 1916.

Isolated from a patient showing symptoms of pulmonary tuberculosis.

Hyphae straight or slightly curved, not tortuous, little branched, 0.4-0.5μ × 1.5 mm., no spirals seen. Chlamydospores and arthrospores rare except on potato glycerol. Conidia rare.

No growth on carrot, potato, acid potato, banana, starch gel, ordinary agar, fruit decoctions with agar on gelatin, turnip, artichoke, or Raulin's gelatin. Growth slow on potato glycerol, colonies 2 mm. in diameter, with a contour irregular and festooned. Surface folded, yellowish white. On Sabouraud agar, growth a little better, colonies 3-4 mm. in diameter, otherwise the same as on potato glycerol. In broth with maltose or glycerol; long, little branched filaments appear in 48 hours. In liquid serum no growth. Maltose and lactose fermented.

Actinomyces transvalensis (Pijper & Pullinger) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 46, 1934.

Nocardia transvalensis Pijper & Pullinger, Jour. Trop. Med. Hyg. **30**: 153-156, *2 pls.,* 1927.

Found in mycetoma pedis in Pretoria, S. Africa. Lesions produced oily pus with whitish grains, 0.5 mm. in diameter, which showed club forms. Pathogenic to guinea pigs, grains with clubs being reproduced.

Hyphae 0.5μ in diameter, beaded, breaking up into cocciform and bacilliform fragments. Organism a strict aerobe, growing very slowly at 22° C., very well at 37° C. Gram-positive, not acid-fast.

In general, colonies circumscribed, adherent, with a white chalky efflorescence. Old cultures rarely show a yellowish tinge. Diastase present. No growth on gelatin, blood serum, Sabouraud agar, broth; very little growth on glycerol broth. On ordinary agar, blood agar, or potato, a thin, white chalky growth appears. On glycerol agar or glycerol potato, growth rich, white, chalky, becoming yellowish, potato turning a dirty gray. White chalky growth on carrot. On glucose or maltose broth, there is a lacy white pellicle. Hay infusion is the best liquid medium. There forms a thin gray pellicle composed of small grains, 360μ in diameter, showing a radial structure but no clubs. No acid or fermentation with any of the usual carbohydrates. Litmus milk shows good surface growth but no clotting or digestion. Scarcely any growth on whey.

Actinomyces fuscus (Karwacki) Sartory & Bailly, Mycoses Pulmonaires 256, 1923.

Streptothrix fusca Karwacki, C. R. Soc. Biol. **66**: 180, 181, 1911, non Corda.

Nocardia fusca Castellani & Chalmers, Man. Trop. Med. ed. 2, 818, 1913.

Oospora fusca Sartory, Champ. Paras. Homme Anim. 809, 1923.

Found in sputum of a tuberculous patient.

Brownish yellow pellicle on liquid media, browning in time, pigment diffusing into medium, making it red brown, then dark brown. Otherwise very close to *A. pulmonalis* Roger [which Karwacki characterizes as follows: optimum temperature 32°-37° C. Deposit of granules in liquid media. No growth on potato and glycerol, coagulated serum and glycerol, or on gelatin. Glycerol agar colonies isolated, circular, white, slightly domed, center adherent. Not pathogenic to laboratory animals. Gram-positive, not acid-fast].

Actinomyces valvulae (Froilano de Mello) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 51, 1934.

Streptothrix valvulas destruens bovis Luginger, Monatsh. Prakt. Thierheilk. **15**: 289-336, *6 figs.*, 1904.

Nocardia valvulae Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 194, 1918.

Oospora valvulas destruens bovis Sartory, Champ. Paras. Homme Anim. 788, 1923.

Found in endocarditis of cattle. Pathogenic to laboratory animals.

Organism a facultative aerobe but grows in depth of agar stab where surface has melted, sealing the stab. Gram-positive.

Colonies on peptone medium hemispheric, small, later becoming more flattened with center elevated and a thin, smooth margin. Growth on milk gray to white. Along agar stab there are clavate projections into the medium, giving an effect suggestive of a row of poplar trees and their reflections in a stream. In broth, there is a slight tubidity, with a mealy sediment, later becoming flocculent. A pellicle is formed. No growth on potato, gelatin, or coagulated ox serum.

Actinomyces bronchialis Sartory, Bull. Sci. Pharm. **23**: 12-19, 1916.

Discomyces bronchialis Neveu-Lemaire, Précis Parasitol. Hum. 43, 1921.

Oospora bronchialis Sartory, Champ. Paras. Homme Anim. 802-805, 1923.

Found in the sputum of a patient suffering with cough, loss of weight, putrid breath. Pathogenic to guinea pigs and rabbits.

Hyphae 0.4-0.5μ in diameter and up to 2 mm. long, regularly branched. Arthrospores and chlamydospores formed. Gram-positive.

No growth on the usual bacteriologic media, either solid or liquid, except maltose broth, peptoglycerol, glucose, maltose and Sabouraud maltose agar, and malt extract. Slight growth on maltose broth. Colonies on Sabouraud (maltose) agar white, shining, with irregular margins, 1 mm. in diameter, in 6 days. In 2 weeks, slightly mammillate and convex, white, finally becoming cream color. Slight decolorization of neutral red. Slight fermentation of glucose, lactose, and maltose.

Actinomyces pulmonalis (Roger, Sartory & Bory) A. Sartory & A. Bailly, Mycoses Pulmonaires 256, 1923.

Oospora pulmonalis Roger, Sartory & Bory, C. R. Soc. Biol. **66**: 150-152, 1909.

Discomyces pulmonalis Brumpt, Précis Parasitol. 1910; Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 186, 1918.

Nocardia pulmonalis Castellani & Chalmers, Man. Trop. Med. ed. 2, 817, 1913.

Found in the whitish grains in the expectoration of a patient with pulmonary mycosis. Also found in otitis. Pathogenic to rabbit and guinea pig, intrapulmonary inoculations producing purulent pleurisy, other inoculations producing local and metastatic abscesses.

Hyphae 0.4-0.5 × 1,500μ, branching with terminal cells, claviform. Spores in chains of 8-10, ovoid or spherical, chlamydospores present. Organism a strict aerobe, growing best at 33°-35° C., not at all at 22° C. Gram-positive, not acid-fast.

Slight development on simple agar. Colonies round, white, odorless on maltose agar. In maltose broth, white flocci at the bottom of the tube. No fermentation.

Actinomyces equi (Chalmers & Christopherson) A. Sartory & A. Bailly, Mycoses pulmonaires 256, 1923; Sartory, Champ. Paras. Homme Anim. 753, 1923.

Streptothrix sp. Dean, Trans. Path. Soc. London **51**: 26-46, 1900.

Nocardia equi Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 263, 1916.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 822, 1923.

Found in nodule on jaw of horse with pale yellow pus, no granules. Pathogenic to laboratory animals.

Hyphae 3-5 × 0.3-0.4μ, curved, club-shaped. Cells occasionally, suggesting *Corynebacterium*, ovoid or ellipsoid cells 0.8-1μ in diameter (chlamydospores?). Hyphae best on ascitic fluid or serum broth. Staining irregular, not acid-fast. Optimum temperature 35°-37° C. Aero-anaerobe.

Growth poor on solid media, dying out after a few generations. On agar or glycerol agar, colonies irregular with angular projections at surface and into depths, suggesting coralloid growth. Depth growth greater than surface growth, maximum 0.5 cm. in diameter, opaque, white, waxy. Stab growth good on upper two centimeters, growth poorer and colonies smaller below. In broth, growth at bottom, liquid clear, once a mass the size of pea, with cauliflower appearance. Maltose broth is favorable to development. Growth in straw, oats, or hay infusion poor. No growth on gelatin, potato, serum, glucose agar, milk, or egg albumen.

Actinomyces Taraxeri-cepapi (Schottmüller) Dodge, n. comb.

Streptothrix Taraxeri-cepapi Schottmüller, Derm. Woch. **58**: Ergänzungsheft: 89-103, 1914.

Found in fever simulating rat-bite fever, following bite by *Taraxerus cepapi,* the African squirrel.

In pus, straight or curved cells, branching not seen, very slender. Organism gram-negative.

No growth on common media, slight growth in broth, to which 5 c.c. of patient's blood was added.

Actinomyces Putorii (Dick & Tunnicliff) Dodge, n. comb.

Streptothrix Putorii Dick & Tunnicliff, Jour. Infect. Dis. **23**: 183-187, *1 fig.,* 1918.

Isolated from blood in case of fever following bite by weasel. Not pathogenic to laboratory animals.

Hyphae slender, curved, branching. Ball and club-shaped swellings. Gram-negative, not acid-fast. A facultative anaerobe, growth better under aerobic conditions.

Growth on blood agar or Loeffler's blood serum as discrete, colorless or grayish white, pinpoint colonies with elevated, sharp margins, dull at first then glistening. Medium not changed. Growth in glucose blood agar more profuse, grayish yellow. In ascitic broth, slight, whitish, flocculent growth. Growth also in inulin, salicin, maltose, mannite, sucrose, raffinose, lactose, or glucose broths to which ascitic fluid is added in the proportion of 1:4. No change in reaction. Only slight growth in plain or dextrose broth or milk; in the former a yellowish white, glistening growth appears.

Actinomyces Muris-ratti (Schottmüller) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 51, 1934.

Streptothrix Muris-ratti Schottmüller, Derm. Woch. **58**: Ergänzungsheft, 77-103, 1914; Blake, Jour. Exp. Med. **23**: 39-60, *Pls. 8-14,* 1916.

Nocardia Muris Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 183, 1918.

Isolated from sodoku or rat-bite fever, also in bronchopneumonia of rats. Reported by Tunnicliff as pathogenic to white rats, not to guinea pigs or rabbits. Reported by Blake (1916) from an old woman with sodoku. He reports it pathogenic to rabbits.

Hyphae slender, tangled, branching, curved in waves or straight, staining homogeneously. Spore chains, of varying length and staining capacities, break up into rods of varying lengths and curvature. Organism is a facultative anaerobe, shows no capsule. Optimum temperature 37° C., little or no growth at lower temperatures. Reported both gram-positive and negative, not acid-fast.

This fungus is difficult to cultivate, giving no growth on potato, plain or glucose agar, ascitic glucose agar, plain or glucose broth, milk or gelatin. On blood agar, colonies fine, grayish white, discrete, elevated, dull becoming glistening. On ascitic agar, growth grayish white. On Loeffler's blood serum, colonies colorless (Schottmüller); colonies whitish, circular, elevated, sharply margined, smooth, glistening, moist, fine (Blake). Similar on human blood agar.

Actinomyces londinensis Brumpt, Précis Parasitol. ed. 4, 1204, 1927.

Streptothrix hominis II Foulerton, Lancet **1**: 970, 971, 1906; Ibid. **1**: 627, 1910.

Nocardia londinensis Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 256, 1916.

Found in an abscess of the tongue. Pathogenic to guinea pig and rabbit.

Claviform formations in broth and whole tufts of hyphae incrusted. On glycerol agar, slight growth, colonies small and white. No growth on potato. Organism a strict aerobe, not acid-fast.

Actinomyces Foulertoni (Chalmers & Christopherson) A. Sartory & A. Bailly, Mycose pulmonaires, 256, 1926.

Streptothrix hominis Foulerton & Jones, Trans. Path. Soc. London **53**: 56-127, 1902.

Nocardia hominis Castellani & Chalmers, Man. Trop. Med. ed. 2, 819, 1913.

Nocardia Foulertoni Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 256, 1916.

Found in abscesses of chest and in sputum. Not pathogenic to rabbits.

No claviform formations. Organism a strict aerobe, growing best at 37° C. Gram-positive, not acid-fast.

On glycerol agar, colonies small and whitish. No growth on potato. On peptone agar, growth slow, colonies small, whitish, heaped up, dry. In inspissated horse serum, growth scanty, colonies sinking into medium. In peptone broth, small, spherical, whitish colonies cohering in flocculent masses.

Actinomyces decussatus (Langeron & Chevallier) Brumpt, Précis Parasitol. 1206, 1927.

Discomyces decussatus Langeron & Chevallier, C. R. Soc. Biol. **72**: 1030, 1031, 1912.

Nocardia decussata Castellani & Chalmers, Man. Trop. Med. ed. 2, 817, 1913.

Oospora decussata Sartory, Champ. Paras. Homme Anim. 825, 1923.

Found in whitish, dry, scaly lesions suggesting pityriasis circinata or marginata. Pathogenicity doubtful.

Hyphae 0.3-0.5μ in diameter, cells 1 × 3-4μ in old hyphae. Arthrospores 1-1.5μ in diameter.

Growth slow on all media. On ordinary agar, at room temperature, colonies milk white, with a prominent button in the center surrounded by a circular moat and four cruciform furrows. No growth on Sabouraud agar. Best growth on beef broth neutralized with calcium carbonate or on peptone agar.

Inadequately Described Species

Actinomyces Genesii (Fróes) Dodge, n. comb.

Nocardia Genesii Fróes, Do mycetoma pedis no Brasil 50, 1930.

Case of Genesio Salles from Bahia. Pathology given in detail by Fróes, Ibid. 181-191, also Rev. Sud-Amér. Méd. Chirurg. **3**: 495-501, 1932.

Isolated from red grain mycetoma pedis in Brazil. Author unable to infect laboratory animals. Grains 150-300μ in diameter, very hard, red; very abundant in tissues. Gram-positive.

Cultures difficult and slow on Sabouraud's agar and potato, red at first, becoming yellowish orange. No growth on liver infusion, broth, milk, egg albumen, or Besredka medium.

Actinomyces putridogenes (Vezspremi) Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 41, 1934.

Cladothrix putridogenes Vezspremi, Centralbl. Bakt. I, **44**: 408-415, 515-523, 1907; Ibid. **45**: 15-33, *1 pl.*, 1907.

Nocardia putridogenes Froilano de Mello & Pais, Arq. Hig. Pat. Exot. **6**: 187, 1918.

Oospora putridogenes Sartory, Champ. Paras. Homme Anim. 823, 1923.

Isolated from greenish pus from gingival ulcers and abscess of the jaw, with periostitis and metastases in lung. Pus contained *Bacillus fusiformis* and *Spirochaeta gracilis* as well as *Actinomyces putridogenes*.

Of doubtful pathogenicity.

Hyphae curved, of varying lengths up to several hundred microns. Grown at 37° C.; at first only bacilli appear. After 3 days, hyphal threads irregularly swollen. Involution forms in old cultures. Organism an aero-anaerobe. Gram-positive and negative.

Streptothrix alba I Sanfelice, Centralbl. Bakt. **36**: 355-367, 1904.

Oospora alba I, Sartory, Champ. Paras. Homme Anim. 817, 818, 1923.

Isolated from the air. Pathogenic to rabbit but not to guinea pig. Strain II is similar, but pathogenic to guinea pig and not to rabbit.

Colonies on agar are shining and white at first, later becoming chalky, easily separable from the substrate. On potato, colonies look like lime.

Anaeromyces bronchitica Chalmers, Douglas & Thomson, Jour. Trop. Med. & Hyg. **24**: 151, 152, *Pls. 1, 2,* 1921.

Cohnistreptothrix bronchitica Verdun & Mandoul, Précis Parasitol. 754, 1924.

This genus is intermediate between *Mycobacterium* and *Actinomyces*.

Actinomyces cameli (Mason) A. Sartory & A. Bailly, Mycoses Pulmonaires 253, 1923.

Streptothrix cameli Mason, Agr. Jour. Egypt. **9**: 7-13, 1919 (1920).

?Oospora cameli Mason in Sartory, Champ. Paras. Homme Anim. 822, 1923.

Found in pseudotuberculous lesions of lungs, ganglia, and kidneys of a camel.

Actinomyces cati Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Discomyces cati Rivolta.

Actinomyces Dori (Beurmann & Gougerot) Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

"*Sporotrichum*" Dor, Presse Méd. **14**: 234, 1906.

Sporotrichum Dori Beurmann & Gougerot, Ann. Derm. Syphiligr. IV, **7**: 996-998, 1906.

Discomyces Dori Beurmann & Gougerot, Les Nouvelles Mycoses 59, 1909.

Rhinocladium Dori Neveu-Lemaire, Précis Parasitol. 84, 1921.

Oospora Dori Sartory, Champ. Paras. Homme Anim. 770, 771, 1923.

Found in subcutaneous abscesses resembling sporotrichosis. Not seriously pathogenic to guinea pig or rabbit.

Mycelium 0.5-1μ in diameter, cells 6-8μ long, hyphae dichotomous, spores 1-1.5μ in diameter.

In broth, a fine deposit of hyphae. Growth slow but much more rapid after adding a drop of acetic acid. Medium remains clear, cultures early lost.

Actinomyces enteritidis (Pottien) Brumpt, Précis Parasitol. ed. 4, 1191, 1927.

Streptothrix enteritidis Pottien, 1902.

Nocardia enteritidis Castellani & Chalmers, Man. Trop. Med. ed. 2, 819, 1913.

Discomyces enteritidis Verdun & Mandoul, Précis Parasitol. 752, 1924.

Aerobe-anaerobe. Brownish colonies on potato.

Actinomyces erysipeloides (Neumann & Lehmann) Lachner-Sandoval, Ueber Strahlenpilze 64, 1898.

Cladothrix des Erythema migrans Rosenbach, Arch. Klin. Chirurg. **36**: 2, 1887.

Streptothrix Rosenbachii Kruse, Flügge Mikroorganismen ed. 3, 1896.

Oospora erysipeloidis Neumann & Lehmann, Atlas und Grundriss der Bakt. 392, 393, 1896.

Discomyces Rosenbachi Gedoelst, Champ. Paras. Homme 177, 1902.

Streptothrix erysipeloides Caminiti, Centralbl. Bakt. I, **44**: 198, 1907.

Nocardia Rosenbachi Gougerot, Gaz. Hôp. **86**: 202, 1913; Castellani & Chalmers, Man. Trop. Med. ed. 2, 815, 1913.

Found in erysipeloid dermatitis.

Mycelium slender with claviform formations, aero-anaerobe.

Growth on gelatin white when young, brownish gray when old, no liquefaction. On agar, growth brown.

Actinomyces Gruberi Terni, Centralbl. Bakt. **16**: 362, 363, 1894.

?Nocardia pluricolor Terni, 1894 [fide Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 268, 1916].

?Actinomyces pluricolor Gasperini, Centralbl. Bakt. **15**: 684, 1894.

Nocardia gruberi Blanchard in Bouchard, Traité Path. Gén. **2**: 855, 1896.

Nocardia pluricolor Froilano de Mello & St. Antonio Fernandes. Mem. Asiatic Soc. Bengal **7**: 110, 1919.

Brillant red on gelatin. Glycerol necessary for pigment production at 20°-30° C., slight metabolism. Pathogenic to guinea pig.

Streptothrix hominis IV Foulerton, 1906, 1910.

Isolated in a case of renal infection secondary to pulmonary infection.

Colonies on agar grayish, gradually darkening. Serum not liquefied.

Actinomyces Lasserrei (Verdun) Brumpt, Précis. Parasitol. ed. 4, 1206, 1927.

Nocardia sp. Lasserre, Contr. Étude Genre Nocardia Thèse Toulouse, 1904.

Nocardia Lasserrei Verdun, Précis. Parasitol. 1912; Castellani & Chalmers, Man. Trop. Med. ed. 2, 819, 1913.

Discomyces Lasserei Neveu-Lemaire, Précis Parasitol. Hum. 43, 1921.

Oospora Lasserei Sartory, Champ. Paras. Homme Anim. 798, 799, 1923.

Found in ulcer of the pharynx and of upper lip. Pathogenic for rabbit and guinea pig in intracerebral injection.

Hyphae 0.5-0.75μ in diameter. Claviform formations present.

Colonies on agar discrete, yellowish, surrounded by a layer of white. On potato, yellow nodules with white snowy efflorescence.

Actinomyces luteus Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

Nocardia lutea Christopherson & Archibald, Lancet **2**: 847, 1918.

Found in dacryocystes at Khartoum.

Streptothrix madurae Solari, Semana Méd. **24**: 573-582, *7 figs.*, 1917 (non Vincent).

Isolated from Madura foot with small yellow grains superficial in skin and muscle, not attacking bone, anesthetizing.

Mycelium septate, without constrictions, brownish drab (similar to filaments killed with osmic acid), branched, perpendicular to main hypha. Chlamydospores present, spherical, terminal, often several in a chain.

On Sabouraud or Sabouraud glucose agar, colonies black, rounded, elevated, smooth, not confluent. Surface not umbilicate. Agar blackened.

Actinomyces odorifer (Rullmann) Lachner-Sandoval, Über Strahlenpilze 65, 1898.

Cladothrix odorifera Rullmann, Chem. Bakt. Unters. . . . Inaug. Diss. München. 47 p., *1 pl.*, 1895.

Streptothrix odorifera Foulerton & Jones, Trans. Path. Soc. London **53**: 112, 113, 1902.

Nocardia odorifera Castellani & Chalmers, Man. Trop. Med. ed. 2, 818, 1913.

Oospora odorifera Sartory, Champ. Paras. Homme Anim. 809, 1923.

Actinomyces Pelletieri (Laveran) Brumpt, Précis Parasitol. ed. 4, 1204, 1927.

Micrococcus Pelletieri Laveran, C. R. Soc. Biol. **61**: 340, 341, 1906.

Oospora Pelletieri Thiroux & Pelletier, Bull. Soc. Path. Exot. **5**: 588, 1912.

Nocardia Pelletieri Pinoy, Bull. Soc. Path. Exot. **5**: 589, 1912 [said by Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916, to be a synonym of *Nocardia indica* (Kanthack) Castellani & Chalmers (*A. madurae*) incorrect].

Discomyces Pelletieri Neveu-Lemaire, Précis Parasitol. 42, 1921.

Found by Laveran in tissue of tumor (not a mycetoma) in a negress in Senegal. Not cultivated. Thiroux & Pelletier report a case of mycetoma in the thorax with evidently some of the lung near the lesion infected and an area in the side of thorax. Usual type of mycetoma with red grains similar to *A. madurae,* but unusual location. Treated externally with iodine, internally with KI, etc. Native thought he was not getting well fast enough and disappeared, balking knowledge of necropsy or cure.

Cells 0.7µ in diameter.

On Sabouraud agar, growth slow; colonies small, cerebriform, coral red, not adhering to the substratum. Mycelium not seen in the tissues, but rather cocciform bodies.

Differs from *A. madurae* in the redder color of colonies, growth only on Sabouraud agar, colonies not penetrating the agar and easily detached from it; colonies mucilaginous instead of scaly and dry, in tissues only in micrococcus form.—Thiroux & Pelletier.

Actinomyces pseudotuberculosae Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

Case of Flexner, Jour. Exp. Med. **3**: 435-450, *Pl. 41,* 1898.

Actinomyces pulmonalis Burnett, Rept. N. Y. State, Vet. Coll. **10**: 167, 1909.

Actinomyces pseudotuberculosis Keller.

Nocardia pseudotuberculosis Froilano de Mello & Fernandes, Mem. Asiatic Soc. Bengal **7**: 110, 1919.

Actinomyces purpureus Cavara, Micosi Occ. 99, 1928. Orloff, Vestnik Ofth. **29**: 653, 1912 [rev. Klin. Monatsbl. Augenheilk. **51**: 529, 1913].

Isolated from lesions of the cornea. Slight virulence for cornea of rabbit, less for dog.

Hyphae branched, sometimes with terminal swellings. Aerobic.

When grown on agar or gelatin, this organism imparts purple color to medium. Large spherical colonies in fish broth. When grown on coagulated serum, purple pigment is produced. Same on potato.

Actinomyces Rogersii Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

Nocardia (*Cohnistreptothrix*) *Rogersi* Froilano de Mello, A Med. Contemp. 1919.

Original reference not seen. Froilano de Mello, in a personal letter dated July 7, 1932, states: "A partially acid-fast *Nocardia*, which further studies have shown to be a contaminating agent which can easily be taken for *B.* of Koch when present in short rods."

Nocardia rubea Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 271, 1916, published without description or synonymy.

Oospora rubra Wilbert, Recueil, Hyg. Méd. Vét. Militaire, 1908.

Actinomyces Somaliensis Brumpt, Précis Parasitol. ed. 4, 1201, 1927.

Indiella Somaliensis Brumpt, Arch. de Parasitol. **10**: 555-562, *Fig. 12,* 1906.

Indielopsis Somaliensis Brumpt, Précis Parasitol. ed. **2**: 1913.

Nocardia Somaliensis Chalmers & Christopherson, Ann. Trop. Med. Parasitol. **10**: 255, 1916.

Streptothrix Somaliensis Miescher, Arch. Derm. Syphilis **124**: 297, *Pls. 20-25,* 1917.

Discomyces Somaliensis Neveu-Lemaire, Précis Parasitol. Hum. 42, 1921.

Parasitic on man in Somaliland (Bouffard).

Mycelium very slender when young, 0.5μ in diameter, white with lateral branches with septa rare. Older filaments remain white, but their form is more irregular, often moniliform. Chlamydospores (?) intercalary, 1.5-2.5μ in diameter. Fungus grows radially and the young peripheral parts are separated from the inflamed tissue by a hyaline zone, taking the colors of the background, and probably protoplasmic. In this zone, an *Actinomyces* is frequently found in association. Grains hard, softened with difficulty by the usual reagents. Material cementing hyphae together takes methylene blue as readily as cells.

Actinomyces urethritidis (Roček) Brumpt, Précis Parasitol. ed. 4, 1206, 1207, 1927.

Isolated by Roček in 1920, later by Schwartz & Cančik (1922) from several cases of prostatitis.

Actinomyces zur-Neddeni Namysłowski, Centralbl. Bakt. I **62**: 564-568, 1912.

Streptothrix sp. zur-Nedden, Klin. Monatsbl. Augenheilk. [N. F. **3**:] **45**: 152-158, *1 fig.,* 1907.

Isolated from eyelid and tear duct. Not pathogenic to guinea pig or rabbit.

Gram-positive. Aerobic.

No growth on milk, potato, or gelatin. On agar, growth suggests *B. xerosis.*

Streptothrix sp. Gauducheau, Bull. Soc. Path. Exot. **3**: 488-490, 1910.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 807, 808, 1923.

Found in greenish yellow grains in pseudotuberculosis which was improved by medication with KI.

Rods 0.3 × 4-5μ, curved slightly. Gram-positive, not acid-fast. Hyphae present.

Authors unable to cultivate.

Discomyces sp. De Senez, Bol. del. Lab. de Bact. de Tucumán (Argentina) **1**: 243-247, *2 figs.*, 1918.

Oospora sp. Sartory, Champ. Paras. Homme Anim. 810, 1923.

Original description not seen.

Sartory describes this organism as follows: Isolated from a case of suppurating otitis. Pathogenic to laboratory animals, especially by intraperitoneal injection.

Hyphae short, little branched. Optimum temperature 37° C.

Growth good on sugar media. On solid media, colony becomes café-au-lait in color, with a white efflorescence.

Actinomyces Bolognesii-Chiurcoi (Vuillemin) Dodge, n. comb.

Malbranchea Bolognesii-Chiurcoi Vuillemin apud Bolognesi & Chiurco, Archivi di Biol. **1**: *13 figs.*, 1925; Pollacci & Nannizzi, I Miceti Pat. Uomo Anim. **5**: No. 46, *5 figs.*, 1926; Bolognesi & Chiurco, Micosi Chirurgiche, Trattato di Micopatologia Umana **2**: 566-574, *10 figs.*, 1927.

Isolated from ulcers on the thorax; grayish seropurulent discharge. Finally metastasis to the lungs. Pathogenic to white rats and guinea pigs.

Mycelium hyaline, branched, 0.7-1.5μ in diameter, septate; fertile hyphae more or less prostrate, branched in compound thyrses, branches arcuate or spiral, producing a few ovoid or cylindric spores, 2.5-5.2μ long, hyaline at first, then reddish.

Colonies on Pollacci medium round, planoconvex, floccose velvety, with a prominent mammillate center, snow white, then with a flesh tint. Growth rapid, after 5 months showing irregular elevations and depressions in the center and concentric zones at the margin. On blood agar and Petragnani medium, the colonies are smaller but similar to those on Pollacci medium.

Actinomyces sp. Ping-Ting-Huang, Derm. Woch. **97**: 1679-1685, *2 figs.*, 1933.

Isolated from actinomycosis dyshidrosiformis in Japan. Dysidrosis of the sago grain type and erosio interdigitalis of the fingers and toes but not keratolysis plantare sulcatum of Acton & McGuire. Not definitely pathogenic for white mouse.

Mycelium 0.5μ in diameter, with long spore chains, spores 0.7-1.0μ in diameter.

On Sabouraud glucose agar, pinhead colonies with chalky surface, confluent into greenish brown colony with white spores, earthy odor. On malt and koji agar, thick brownish colonies with white spore covering. On Petragnani medium, yellowish folded nodules with malachite green margins. On peptone agar, white punctiform colonies with reddish reverse. On potato, thick tumid colonies with granular uneven surface covered by a powder of white spores. Litmus broth becomes blue, milk coagulated in 10 days, hemolysis present.

BIBLIOGRAPHY

Aars, C. G. 1930. Madura foot; its histology and mycology, *Arch. Derm. Syphilol.* 21: 571-574, *3 figs.*

Abbott, A. C. & N. Gildersleeve. 1902. On the actinomycose-like development of some of the acid resisting bacilli, *Centralbl. Bakt.* I, 31: 547-550, *1 pl.*

Acosta, E. 1894. Nueva propriedad del Cladothrix invulnerabilis, *Crón. Méd. Quirúrg. Habana* 20: 479-481.

Acosta, E. & Grande Rossi. 1893. Descripción de un nuevo Cladothrix (Cladothrix invulnerabilis), *Crón. Méd. Quirúrg. Habana* 19: 97-100.

Acton, Hugh W. & C. McGuire. 1930. Keratolysis plantare sulcatum, a lesion due to an actinomycotic fungus, *Indian Med. Gaz.* 65: 61-65, *3 pls.*

—. 1931. Actinomycotic lesions of the hands and feet due to Actinomyces keratolytica n. sp. *Indian Med. Gaz.* 66: 65-70, *3 pls.*

Adami, J. George & Robert C. Fitzpatrick. 1896. Further observations upon Madura foot disease in America, *Montreal Med. Jour.* 24: 485-490, *3 figs.*

Adami, J. George & B. A. Kirkpatrick. 1895. A case of Madura foot disease (mycetoma pedis, ochroid variety), *Trans. Ass. Am. Physicians* 10: 92-100, *3 figs.*

*Affansajew. 1888. Über die klinische Mikroskopie und Bakteriologie der Aktinomykose, *Petersb. Med. Wochenschr.*

Almeida, Floriano Paulo de. 1930. Mycetoma actinomycosica de grãos pretos, *Annaes Fac. Med. São Paulo* 5: [1-7] *4 pls.*

*Algorta-Scaltritti, Mañé. 1907. Un caso de actinomicosis, *Rev. Méd. Uruguay* 10: 274.

Almquist, Ernst. 1890. Untersuchungen über einige Bacteriengattungen mit Mycelien, *Zeitschr. Hyg.* 8: 189-198, *Pl. 6.*

Amaral, Zephyrino do & A. Yasbek. 1919. Actinomycose de localização rare dando origem a formação de um mycetoma, *Brasil Med.* 33: 221.

Anderson, Charles. 1925. Sur quatre nouvelles observations tunisiennes de mycétome, *Arch. Inst. Pasteur Tunis* 14: 90-92.

Anderson, Charles & R. Broc. 1930. XXe cas de pied de Madura observé en Tunisie, *Arch. Inst. Pasteur Tunis* 19: 323, 324.

Aoyama, T. & S. Miyamoto. 1901. Ueber die menschenpathogene Streptothrix, *Mitt. Med. Fak. K. Jap. Univ. Tokio* 4: 231-276, *Pls. 16-18.*

Archibald, R. G. 1910. Human botryomycosis, *Brit. Med. Jour.* 2: 971, 972 [Reprinted in *Rept. Wellcome Trop. Res. Lab.* 4A: Med.: 337-342, *Pl. 15,* 1911].

Arlo, J. 1913. Pied de Madura avec envahissement du triangle de Scarpa et de la partie inférieure de la paroi abdominale, *Bull. Soc. Path. Exot.* 6: 485-487.

Artault, Stephen. 1900. Sur quatre cas d'actinomycose, *Arch. de Parasitol.* 3: 209-227.

Artom, Mario. 1930. Micetoma actinomicosico de piede (piede di Madura), *Giorn. Ital. Derm. Sifilol.* 71: 1516-1532, *2 pls.*

Aschoff, A. 1895. Ein Fall von primärer Lungenaktinomykose, *Berlin. Klin. Woch.* 32: 738-740, 765-768, 786-789.

Babes, V. 1913. Der Madurafuss (Aktinomyces des Fusses, Perical, Mycetom), *Handb. Path. Mikroorg.* [Kolle & Wassermann] 5: 365-390, *3 pls.*

Baerts, F. 1925. Discomyces congolensis, agent étiologique d'actinomycose nouvelle occasionnant des lésions attribuées jusqu' à precent à la syphilis, au pian ou au phagdénisme, *Bull. Méd. Katanga* 2: 67-75.

Bailly, Amour. 1921. Contribution à l'étude des mycoses pulmonaires, étude d'une nouvelle espèce d'Oospora, Oospora catarrhalis n. sp., *Univ. Strasbourg Fac. Pharm.* 4: 1-85, *Pls. 1-5.*

Bainbridge, G. 1883. A case of mycetoma of the foot, pale variety with implication of the lymphatics of the lower extremity and probably those of the abdomen, *Trans. Med. Phys. Soc. Bombay* 1882: 32.

Bajardi, A. 1903. Die Streptothrix lingualis (Syn. Vibrio Spirosoma linguale) im Munde der Gesunden und der Dipterischen, *Centralbl. Bakt.* I, 35: 129-137, *1 pl.*

Balzer, Félix. 1883. De l'erythrasma (Microsporum minutissimum), *Ann. Derm. Syphiligr.* II, 4: 681-688.

Bang, B. 1884. Die Strahlenpilzerkrankung (Actinomykoses), *Deutsch Zeitschr. Thiermed. Vergleich Path.* 10: 249-264.

Barboni, Elio. 1931. Di un caso di Actinobacillosi di Agello umbro, *Riv. Biol.* 13: 156-163, *1 pl.*

Barlow, R. A. 1925. Actinomycosis of the tongue, *Laryngoscope* 35: 314-316.

Battaglia, Mario. 1928. Eumycetom der Schleimhaut des Gaumes, *Centralbl. Bakt.* I, 105: 407-411, *2 figs.*

Behla, Robert. 1898. Über die systematische Stellung des Erregers der Aktinomykose, *Centralbl. Bakt.* I, 23: 817-829.

Beigelman, M. N. 1933. Actinomycosis of the orbit, *Arch. of Ophthalmol.* 10: 664-673, *2 figs.* [old ser. 67].

Bell, Howard H. 1922. Infection of the meninges and lungs by a species of Actinomyces, *Jour. Infect. Dis.* 30: 99-106.

Bellisari, G.: 1904. Sulla presenza e sulla patogenità di Streptotricee nelle polveri, residui di cereali, *Ann. Ig. Sperim.* 14: 467-483.

Bérard, Del-Marie Gustave. 1894. De l'iodure de potassium dans l'actinomycose, *Thèse Fac. Méd. Pharm. Univ. Bordeaux* 13: 1-43.

Bérard, Léon & Joseph Nicolas. 1900. Note sur la résistance des spores de l'Actinomyces, *C. R. Soc. Biol.* 52: 835, 836.

*Berestnev, N. 1897. Actinomykose und ihre Erreger, *Inaug. Diss. Moscou.* 206 pp., *4 pls., 1 col. pl.*

—. 1898. Über Pseudoactinomykose, *Zeitschr. Hyg.* 29: 94-116, *Pls. 1-3.*

—. 1899. Zur Frage der Classification und systematischen Stellung der Strahlenpilze, *Centralbl. Bakt.* 26: 390.

Bernardinis, D. di. 1904. Ulcera corneale da Streptothrix, *Ann. Ottalm. e Lavori Clin. oculistica di Napoli* 33: 914-924, *1 pl.*

—. 1904. Ulcera corneale da Streptothrix, *Ann. Ig. Sperim.* 14: 461-466, *Pl. 4.*

Bernardinis, D. di & A. di Donna. 1905. Due case di ulcera corneale de Streptothrix, *Ann. Ig. Sperim., N. S.* 15: 489-497, *Pls. 8, 9.*

Bettray, Wilhelm. 1932. Die Bedeutung der Aktinomyzeten für die Bildung der Speichelsteine, *Diss. Med. Fak. Univ. Rostock,* 20 pp.

Bevan, Arthur Dean. 1905. Treatment of actinomycosis and blastomycosis with copper salts, *Jour. Am. Med. Assn.* 45: 1492, 1493.

Beysiegel, Karl. 1933. Aktinomykose des ohres und Kehlkopfs, *Diss. Med. Fak. Univ. Würzburg,* 17 pp.

Birt, C. & W. B. Leishman. 1902. A new acid-fast Streptothrix pathogenic to man and animals, *Jour. Hyg.* 2: 120-128, *1 pl.*

Bizzozero, J. 1884. Über die Mikrophyten der normalen Oberhaut des Menschens, *Arch. Path. Anat. Phys.* [Virchow] 98: 441-459.

Blake, Francis G. 1916. The etiology of rat bite fever, *Jour. Exp. Med.* 23: 39-60, *Pls. 8-14.*

Blanc, Georges & Henry Bouquet. 1917. Un cas de mycétome à Nocardia Madurae observé en Tunisie, *Bull. Soc. Path. Exot.* 10: 431-435, *1 pl.*

Blanchard, Raphaël. 1899. Quelques cas anciens d'actinomycose, *Arch. de Parasitol.* 2: 329-342.

Blanchard, Raphaël & E. Nocard. 1896. Sur une mémoire de M. le Dr. E. Legrain (de Bougie) intitulé: Note sur un nouveau cas de pied de Madura observé en Algérie, *Bull. Acad. Méd.* [Paris] III, 36: 753-757.

Bloomfield, Arthur & Stanhope Bayne-Jones. 1915. A case of abscess of the liver due to a Streptothrix, *Johns Hopkins Hosp. Bull.* 26: 230-233, *3 figs.*

Bode, H. G. 1933. Ueber klinische Identität von Kolliquativer Haut- tuberkulose und Actinomykose, *Arch. Derm. Syphilis* 167: 550-559.

Bodin, E. & C. Lenormand. 1901. Note sur la production de casease par une Streptothrix parasite, *Ann. Inst. Pasteur* 15: 279-288.

Bolognesi, Giuseppe & Georgio Alberto Chiurco. 1923. Sur la patogenesi del noma, *Patologica* 15: 406-408, *3 figs.*

Bonnet, Denis. 1896. De l'actinomycose de la langue, *Thèse Fac. Méd. Pharm. Lyon.* II, 8: 63 pp.

Bory, L. 1914. Recherches expérimentales sur les Oosporoses, *Premier Congres. Internat. Path. Comp.* 1912, 2: 185-193.

Bostroem, E. 1891. Untersuchungen über die Aktinomykose des Menschen, *Beitr. Path. Anat. Allg. Path.* 9: 1-240, *Pls. 1-10.*

Boyce, Robert. 1894. Eine neue Streptothrixart, gefunden bei der weissen Varietät des Madurafusses, *Hyg. Rundschau* 4: 529-531.

Boyce, Robert & Nusserwangi F. Surveyor. 1893. Madura disease (Mycetoma Carteri), *Lancet* 1: 932, 933.

—. 1894. On the existence of more than one fungus in Madura disease (Mycetoma), *Phil. Trans. Roy. Soc.* [London] B 185: 1-14, *Pls. 1-4.*

—. 1894. The fungus foot disease of India, *Brit. Med. Jour.* 2: 638, 639.

Brault, J. 1899. Contribution à l'étude de l'actinomycose un cas d'actinomycose constaté à Alger. Péritonite actinomycosique chez le lapin et le cobaye, *Arch. de Parasitol.* 2: 535-547.

—. 1906. Mycétome à forme néoplasique simulant un fibrosarcome de la face dorsale du pied, *Bull. Mém. Soc. Chir. Paris* 32: 589-594, *2 pls.*

—. 1907. Étude anatamo-pathologique et bactériologique d'une maladie dite de Madura à forme néoplasique, *Arch. Méd. Expér.* 19: 145-151, *Pl. 6.*

Breinl, A. 1915. On the occurrence and prevalence of diseases in British New Guinea, *Ann. Trop. Med. Parasitol.* 9: 285-318, *Pls. 19-26, 1 map.*

Brocq-Rousseu, D. 1904. Sur une Streptothrix cause de l'altération des avoines moisies, *Rev. Gén. Bot.* 16: 219-230.

Bruini, G. 1905. Über die thermophil Mikrobenflora des menschlichen Darmkanals, *Centralbl. Bakt.* I, 38: 177-185, 298-307, *15 figs.*

Brumpt, Émile. 1902. Mycétome à grains blancs, *Arch. de Parasitol.* 5: 156-158.

—. 1906. Les mycétomes, *Arch. de Parasitol.* 10: 489-572. Also as *Thèse Fac. Méd. Paris,* 94 pp., *10 pls.*

Brun, R. G., R. Broc, E. Burnet, C. Anderson & P. Solovief. 1923. Trois nouveaux cas de mycétome (pied de Madura) observés en Tunisie, *Arch. Inst. Pasteur Tunis* 12: 199-204, *1 pl.*

Bruns, Hayo. 1899. Zur Morphologie des Aktinomyces, *Centralbl. Bakt.* 26: 11-15.

Buchholtz, Hermann. 1897. Über menschenpathogenen Streptothrix. Ein Beitrag zur Ätiologie des acuten Lungenzerfalls, *Zeitschr. Hyg.* 24: 470-487.

Bull, L. B. 1929. Dermatomycosis of the sheep (lumpy or matted wool) due to Actinomyces dermatonomus (n. sp.), *Australian Jour. Exp. Biol. Med. Sci.* 6: 301-314, *2 pls.*

Bulloch, W., Leonard Colebrook, F. Griffith & R. St. John-Brooks. 1931. Actinomycosis and similar conditions, *Syst. Bact. in Relation to Med.* 8: 71-90.

Burkhard, H. 1916. Fall von Aktinomykose der Haut (mit lokaler Salvarsaninjektion), *Arch. Derm. Syphilis* 121: 697-705, *pl. 24.*

Burnet, Etienne, R. Broc, G. Brun & H. Jannin. 1924. XIIIe observation Tunisienne de mycétome. Extension de l'infection aux ganglions cruraux, inguinaux et iliaques, *Arch. Inst. Pasteur Tunis* 13: 306-309, *2 pls.*

Burnet, Etienne, & G. Brun. 1926. XVIIe observation Tunisienne de mycétome, *Arch. Inst. Pasteur Tunis* 15: 151-153, *1 fig.*

Butterfield, Elmore C. 1905. A case of pulmonary infection with an acid-fast Actinomyces, *Jour. Infect. Dis.* 2: 421-430, *Pl. 15.*

Burnier, & Duché. 1933. Mycose eczématiforme due à un Actinomyces du groupe albus, *Bull. Soc. Franç. Derm. Syphiligr.* 40: 581.

Callender, G. R. & J. F. Coupal. 1922. An unusual case of Nocardiosis, *Jour. Infect. Dis.* 30: 601-609, *5 figs.*

Caminiti, R. 1907. Über eine neue Streptothrixspecies und die Streptothricheen in allgemeinen, *Centralbl. Bakt.* I, 44: 193-208, *4 pls.*

Cann, L. W. & G. J. Hollis. 1931. A case of actinomycotic cerebrospinal meningitis associated with aural actinomycosis, *Lancet* 220: 130, 131.

Carini, A. 1913. Sopra un caso di micetoma della guancia, *Giorn. Ital. Mal. Ven. Pelle* 54: 256-258.

Castellani, Aldo. 1912. Further researches on trichomycosis flava, rubra et nigra of the axillary regions, *Proc. Roy. Soc. Med.* 6: Derm.: 23-27, *2 figs.; Brit. Jour. Derm. Syphilis* 25: 14-19, 1913.

—. 1923. Case of trichomycosis axillaris rubra, *Proc. Roy. Soc. Med.* 16: Derm.: 97, 98,

Castellani, Aldo & A. Geden-Wilkinson. 1922. Observations on trichomycosis axillaris flava, rubra et nigra, *Brit. Jour. Derm. Syphilis* 34: 255-266, *1 pl.* [Approximately same title, *Jour. Trop. Med. Hyg.* 26: 186-190, *1 pl.,* 1923.]

*Catanei, A. 1925. *Arch. Inst. Pasteur Algérie* 3: 379-393.

Catanei, A., L. Grosdemange & Ch. Legroux. 1927. Sur un cas de myétome du pied observé en Algérie, *Bull. Soc. Path. Exot.* 20: 11-13.

Catanei, A. & Ch. Legroux. 1931. Étude d'un cas d'actinomycose pleuropulmonaire observé en Algérie, *Bull. Soc. Path. Exot.* 24: 85-88.

—. 1931. Un nouveau cas de myétome observé en Algérie, *Arch. Inst. Pasteur Algérie* 9: 378-381, *Pls. 17, 18.*

Cazabó, Ruiz. *See* Ruiz Cazabó, Manuel.

Cecil, H. L. & J. H. Hill. 1922. Actinomycosis of the urinary organs. Report of a case of pyelonephritis in which Actinomyces bovis was found, *Jour. Am. Med. Ass.* 78: 575-578.

Chalmers, Albert J. & R. G. Archibald. 1918. Paramycetoma, *Jour. Trop. Med. Hyg.* 21: 177, 178, *2 pls.*

Chalmers, Albert J. & J. B. Christopherson. 1916. A Sudanese actinomycosis, *Ann. Trop. Med. Parasitol.* 10: 223-282, *Pls. 8-11.*

Chalmers, Albert J. & W. R. O'Farrell. 1913. The trichonocardiases, *Ann. Trop. Med. Parasitol.* 7: 524-540, *Pls. 36, 37.*

Chalmers, Albert J. & A. D. Stirling. 1913. Epidemic trichonocardiasis, *Ann. Trop. Med. Parasitol.* 7: 541-544, *2 figs.*

Charrin, A. & G. Delamare. 1902. Nature parasitaire (Oospora) de certaines dégénérescences calcaires de quelques tumeurs inflammatoires et de lésions spéciales du squelette, *C. R. Acad. Sci.* 135: 255-257.

Chatschaturjan, see Khachaturian.

Chavarría, Antonio Peña. *See* Peña Chavarría, Antonio.

Chiurco, Gorgio Alberto. 1926. L'infezione actinomicotica dei mascellari, *Atti R. Accad. Fisiocrit. Siena* X, 1: 21-27.

—. 1928. La forma raggiata e le clave non son caratteri peculiari del'Actinomyces bovis Boll. & Harz, *Atti R. Accad. Fisiocrit. Siena* X, 2: 499-521.

Christopherson, J. B. & R. G. Archibald. 1918. Primary nocardiosis of the lacrimal gland, *Lancet* 2: 847.

Ciechanowski, Stanislaw. 1903. Zur Actinomycesfärbung in Schnitten, *Centralbl. Bakt.* I, 33: 238, 239.

Claypole, Edith J. 1913. On the classification of the Streptothrices, particularly in their relation to bacteria, *Jour. Exp. Med.* 17: 99-116, *Pls. 8-10.*

Clegg, M. T. & W. C. Hobdy. 1915. A case of mycetoma in Hawaii, its etiology, *Am. Jour. Trop. Dis. Prevent. Med.* 3: 534-544, *Pl. 10.*

Cohn, Ferdinand. 1875. Untersuchungen über Bakterien II, *Beitr. Biol. Pflanzen.* 1: 141-208, *Pls. 5, 6.*

Connaway, J. W. 1921. Actinomycosis (lump jaw, big jaw, and wooden tongue), *Missouri State Bull.* 186: 3-16, *9 figs.*

Cornejo, Andrés. 1932. Tres casos de micetomas podales, *Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán* 7: 480-495, *21 figs.*

Cornwall, J. W. 1904. Notes on the cultivation of Streptothrix madurae, *Indian Med. Gaz.* 39: 208, 209.

Cornwall, J. W. & H. M. Lafrenais. 1922. A new variety of Streptothrix cultivated from mycetoma of the leg, *Indian Jour. Med. Res.* 10: 238-248.

Cozzolino, Vincenzo. 1900. Ein neues Fadenbacterium, eine pseudoactinomykotische Erkrankung erzeugend, *Zeitschr. Hyg.* 33: 36-51.

—. 1900. Ueber einen Falle von Pseudoactinomykose der äusseren Ohrgegend, von einem Fadenbacterium hevorgerufen, *Arch. Ohrenheilk.* 50: 199-206, *Pl. 6.*

*Cranwell, D. 1904. Contribución al estudio de la actinomicosis humana, *Tesis, Buenos Aires.*

Crookshank, Edgar M. 1897. Actinomycosis and Madura disease, *Lancet* 1: 11-18, *1 pl.*

*Daubney, R. 1927. Bovine lymphangitis or tropical actinomycosis, *Jour. Comp. Path. Therapeutics* 40: 195-216, *8 figs.*

Davis, D. J. & Onfre Garcia. 1923. Experimental study of a pathogenic acid-fast Actinomycete (Nocardia), *Arch. Derm. Syphilol.* 7: 1-13, *1 pl.*

Dean, George. 1900. On a new pathogenic Streptothrix, *Trans. Path. Soc. London* 51: 26-46.

Delanoë, P. 1928. Mycétome de la cuisse observé chez un marocain adulte dû à un microsiphonée Nocardia Nicollei n. sp., *Arch. Inst. Pasteur Tunis* 17: 257-274.

Delbanco, Ernst. 1897. Ein amerikanischer Fall von Mycetoma pedis, *Deutsche Med. Zeitung* 18: 497-500.

—. 1898. Eine neue Strahlenpilzart nebst Bemerkungen über Verfettung und hyaline Degeneration, *München. Med. Woch.* 45: 48-50, 82-85.

*Demicheri, L. 1899. Actinomicosis conjuntival. Granulaciones actinomicósicas, *Rev. Méd. Uruguay* 2: 145.

Dessy, Giorgio. 1926. L'immunità nella streptotricosi, *Boll. Ist. Sieroterapico Milanese* 5: 399-416.

—. 1928. La chemioterapia della Streptotricosi, *Boll. Ist. Sieroterapico Milanese* 7: 25-44.

*Devicenzi, G. 1908. Sobre un caso de actinomicosis glútea, *Rev. Hospitales* 1: 64.

Diaz Albertini, Antonio. 1902. Nota adicional, *Tercer Congr. Méd. Pan-Americano, La Habana, Cuba,* 1901. 1: 420-424, *3 pls.*

Diaz Albertini, Antonio & Carlos M. Desvernine. 1902. Nota preliminar sobre dos casos de pie de Madura, *Tercer Congr. Méd. Pan-Americano, La Habana, Cuba,* 1901 1: 411-420, *1 pl.*

Dick, George F. & Ruth Tunnicliff. 1918. A Streptothrix isolated from the blood of a patient bitten by a weasel (Streptothrix putorii), *Jour. Infect. Dis.* 23: 183-187, *1 fig.*

Doepke, Karl. 1902. Beiträge zur Kenntnis des Erregers des menschlichen Aktinomykose, *München. Med. Woch.* 49: 873-875.

Dohi, Keizo & M. Koike. 1913. Klinische, histologische und bakteriologische Beiträge zur Kenntnis von Mycetoma pedis in Japan. *Jap. Zeitschr. Derm. Urol.* 13: 531-570, *2 pls., 12 figs.* [38, 39].

Domec, Th. 1892. Contribution à l'étude de la morphologie de l'Actinomyces, *Arch. Méd. Exp. Anat. Path.* 4: 104-113.

Donna, A. di. 1904. Su di una Streptothrix patogena con esperimente sull'immunizzazione, *Ann. Ig. Sperim.* 14: 449-459, *Pl. 3.*

Dor, Louis. 1896. Une nouvelle mycose à grains jaunes; ses rapports avec l'actinomycose; est-ce une variété de l'actinomycose ou une espèce différente? *Gaz. Hebd. Méd. Chirurg. N. S.* 1: 553, 554.

—. 1906. La sporotrichose (abcès sous-cutanés multiples), *Presse Méd.* 14: 234.

DuBois Saint Severin, L. M. 1895. Sur une conjunctivité streptothrique curable par les applications de jus de citron, *Semaine Méd.* 15: 202.

—. 1895. Note sur une Streptothricée parasite (Streptothrix aurea), *Arch. Med. Nav. Coloniale* 63: 252-260.

Dubreuilh, W. & D. Frèche. 1895. L'actinomycose dans le sud-ouest de la France, *Ann. Derm. Syphiligr.* III, 6: 788-803. Also *Cong. Franç. Méd. Bordeaux* 1895: 2: 987-1003, 1896.

Duncker, H. C. J. 1891. Ein neues Färbungsmittel für Actinomyces bovis, *Zeitschr. Fleisch. Milchhyg.* 1: 56, 57.

*Durante, Carlos A. 1910. Segunda observatión de pie de Madura o micetoma en la república Argentina, *Tesis Buenos Aires.*

Elschnig. 1895. Actinomyces im Thränenröhrchen, *Klin. Monatsbl. Augenheilk.* 33: 188-191.

Eppinger, Hans. 1890. Über eine neue pathogene Cladothrix und eine durch sie hervorgerufene Pseudotuberculosis, *Wien. Klin. Woch.* 3: 321-323.

—. 1891. Über eine neue pathogene Cladothrix und eine durch sie hervorgerufene Pseudotuberculosis (Cladothrichica), *Beitr. Anat. Allg. Path.* 9: 287-328.

—. 1896. Die durch Cladothriceen (Streptothriceen usw.) hervorgerufenen Erkrankungen, *Ergebn. Allg. Path. Path. Anat. Mensch. Tiere* 3: 1: 328-364.

Ernst, Wilhelm. 1902. Über Nekrosen und den Nekrosebacillus (Streptothrix necrophora), *Monatsh. Prakt. Tierheilk.* 14: 193-228.

Escomel, E. 1914. Sur l'actinomycose humaine de Pérou, *Bull. Soc. Path. Exot.* 7: 380, 381.

—. 1915. Sur un nouveau cas d'actinomycose au Pérou, *Bull. Soc. Path. Exot.* 8: 571-573.

—. 1924. Essai sur la parasitologie d'Aréquipa (Pérou), *Bull. Soc. Path. Exot.* 17: 906-925 [mycoses pp. 917-924].

Feistmantel, Carl. 1902. Säure und alkoholfestigkeit der Streptothrix farcinica und die Beziehung der Streptothricheen zu den säurefesten Pilzen, *Centralbl. Bakt.* I, 31: 433-445.

Feit, Hermann. 1928. Actinomycosis, cutaneous and systemic, *Arch. Derm. Syphilol.* 17: 791-794.

Ferré, J. & E. Faguet. 1895. Sur un abcès du cerveau à Streptothrix, *Semaine Méd.* 15: 359. [*C. R. Ass. Franç. Av. Sci. Bordeaux* 24: 2: 822-825, 1895.]

Filmer, J. F. 1930. ''Lumpy or matted wool,'' or mycotic dermatitis in sheep, *Jour. Dep. Agr. West Australia* II, 7: 571, 572.

Fish, Pierre A. 1895. Leeches, a histological investigation of two cases of equine mycosis with a histological account of a supposed similar disease called Bursattee occurring in India, *Ann. Rept. U. S. Bur. Anim. Ind.* 12-13: 229-259, *Pls. 19-25.*

Flexner, Simon. 1898. Pseudo-tuberculosis hominis streptothrica, *Jour. Exp. Med.* 3: 435-450, *Pl. 41.*

Fontoynont, Maurice & J. Carougeau. 1910. Nodosités juxta-articulaires, mycose due au Discomyces Carougeaui, *Arch. de Parasitol.* 13: 583-620.

Fontoynont, Maurice & Pax Salvat. 1922. Sur une actinomycose du rat à Madagascar, *Bull. Soc. Path. Exot.* 15: 596-607.

Foulerton, Alexander G. R. 1906. Pathology of Streptothrix infection, *Lancet* 1: 970, 971.

—. 1906. The pathology of Streptothrix infections, *System of Medicine* [Allbut, Clifford & Humphry Davy Rolleston] ed. 2, 2: 1:302-324, *4 figs.*

—. 1910. The Milroy lectures on the Streptotrichoses and tuberculosis, *Lancet* 1: 551-556, 626-631, 769-773.

Foulerton, Alexander G. R. & C. Price Jones. 1902. On the general characteristics and pathogenic actions of the genus Streptothrix, *Trans. Path. Soc. London* 53: 56-127, *1 pl.*

Fox, Herbert. 1923. Disease in captive wild mammals and birds, incidence, description, comparison, Philadelphia, J. B. Lippincott [see pp. 567-595].

Francke, V. 1921. Zwei Fälle von Streptothrix im Tränenöhrchen, *Klin. Monatsbl. Augenheilk.* 67: 444, 445.

Froes, Heitor Praguer. 1932. Sur un champignon brésilien producteur de mycetome á grains rouges (Nocardia Genesii H. Froes, 1930), *Rev. Süd-Amer. Med. Chirurg.* 3: 495-501, *6 figs.*

*Froilano de Mello, Indalencio. 1919. Nocardia (Cohnistreptothrix) Rogersi sp. nov. parasite des voies respiratoires d'un soidisant tuberculeux, *A. Med. Contemp.*

Froilano de Mello, Indalencio & Antonio S. Ana Pais. 1918. Um caso de nocardiose pulmonar simulando a tisica, *Arq. Hig. Pat. Exot.* 6: 133-206.

Froilano de Mello, Indalencio & J. F. St. Antonio Fernandes. 1919. Revision de champignons appartenant au genre Nocardia, *Mem. Asiatic Soc. Bengal* 7: 103-138.

Fuchs, Ernst. 1903. Über Farbbarkeit der Streptotricheen nach Methoden der Tuberkelbacillenfarbung, *Centralbl. Bakt.* I, 33: 649-655.

Fürbringer. 1921. Zur Kenntnis der Leptothrixangina, *Berlin. Klin. Woch.* 58: 437-439.

Funfack, Max. 1926. Ein Fall von primärer Aktinomykose am Zungenrande, *Derm. Zeitschr.* 46: 25-28.

Gammel, John A. 1934. Actinomycosis without granules, *Arch. Derm. Syphilol.* 29: 287-297, *4 figs.*

Garten, J. 1895. Über einen beim Menschen chronische Eiterung erregenden pleomorphen Mikroben, *Deutsch. Zeitschr. Chirurg.* 41: 257-285, *Pl. 6.*

Gasperini, Gustavo. 1890. Recherches morphologiques et biologiques sur un microorganisme de l'atmosphère, le Streptothrix Foersteri Cohn, *Ann. Micrographie* 2: 449-474, *Pls. 5-7.*

*—. 1892. Ulteriori ricerche sul genere Streptothrix come contributo allo studio dell'actinomyces di Harz, *Rev. Gen. Ital. Clin. Med.*

—. 1892. Ricerche morfologiche e biologiche sul genere Actinomyces Harz come contributo allo studio delle relative micosi, *Ann. Ist. Ig. R. Univ. Roma* 2: 167-229, *2 pls.*

—. 1894. Versuche über das Genus Actinomyces (XIe Congrès Internat. Méd. Rome), *Centralbl. Bakt.* 15: 684-686.

*—. 1895. Sul potere patogeno dell'Actinomyces albus e sui rapporti fra attinomicosi e tuberculosi, *Soc. Toscana Sci. Nat. Pisa.*

*—. 1896. Nuove ricerche sul'attinomicosi sperimentale, *Soc. Toscana Sci. Nat. Pisa.*

Gémy & H. Vincent. 1892. Sur une affection parasitaire du pied non encore décrite (variété du pied de Madura?), *Bull. Soc. Franç. Derm. Syphiligr.* 3: 285-292, *1 pl.* Also *Ann. Derm. Syphiligr.* III, 3: 577-584, *1 pl.*

—. 1896. Sur un nouveau cas de pied de Madura, *Ann. Derm. Syphiligr.* III, 7: 1132, 1133.

Gerken, Ernst. 1931. Das Schicksal der Wegen Aktinomykose behandelten Fälle, *Diss. Med. Fak. Univ. Kiel* 27 pp.

Gibbes, Heneage. 1890. Miescher's or Rainey's corpuscles in Actinomyces, *Ann. Surgery* 11: 96-101, *2 figs.*

Gibson, A. G. 1920. A new pathogenic form of Streptothrix, *Jour. Path. Bact.* 23: 357, 358.

Gilbert, G. Burton. 1922. Report of a few unusual lung infections, *Southwestern Med.* 6: 43-46, *4 pls.*

Gomes, J. M. 1923. Nocardiose de localização rara, *Ann. Paulistas Med. Cirurg.* 14: 150-156.

Gougerot, H. 1909. De l'utilité de reconnaitre à leur ombre. Les parasites dépourvus d'électivité colorante, *C. R. Soc. Biol.* **67**: 578-580.

—. 1913. Oosporoses ou nocardoses cutanées. Synonymie: nocardoses oosporoses, discomycoses, micromycoses, microsiphonoses, actinomycoses, streptothricoses, *Gaz. Hôp.* **86**: 149-158, 197-204.

—. 1925. Tuberculoses et nocardioses éléphantiasiques ulcéreuses et fistuleuses recto-ano-périnéo-génitales et buccales, *Presse Méd.* **33**: 2: 1121-1126, *2 figs.*

*Greco, Nicolas V. 1904. Primer caso de pie de maduro o micetoma en la república Argentina, *Tesis Buenos Aires.*

Grigorakis, Léonidas. 1932. Morphologie et cycle évolutif des Actinomyces, *C. R. Acad. Sci.* **194**: 641-643.

Gross, F. & Heully. 1911. Actinomycose de la paroi thoracique et de la cuisse, *Rev. Méd. de l'Est.* **43**: 499-501.

*Gruber, Max. 1892. Über eine neue Eiterung erregende Microbienart Micromyces Hofmanni, *Trans. 7th Internat. Congr. Hyg. Demography, 1892,* **2**: 65.

—. 1892. Micromyces Hofmanni, eine neue patogene Hyphomycetenart nach Untersuchungen von G. von Hofmann-Wellenhof und Th. von Genser, *Arch. Hyg.* **16**: 35-52, *Pl. 1.*

Grupen, Joachim. 1923. Geschlossene Aktinomykose der Zunge, *Deutsch. Zeitschr. Chirurg.* **183**: 286, 287.

Gruter, Wilhelm. 1933. Eine Pilzgeschwulst (Aktinomykose) in oberen Tränenröhrchen (Actinomyces discofoliatus), *Zeitschr. Augenheilk.* **79**: 477-510, *13 figs.* [*Klin. Woch.* **12**: 1198, 1933].

Guéguen, Fernand. 1908. Sur la position systématique des Achorions et de Oospora à mycélium fragmentifié, *C. R. Soc. Biol.* **64**: 852-854.

—. 1909. Sur Oospora lingualis nov. sp. et Cryptococcus linguaepilosae Lucet, parasites de la langue noire pileuse, *Arch. de Parasitol.* **12**: 337-360, *21 figs.*

Guermonprez & Becue. 1894. Actinomycose, *Bibl. Méd.* [Charcot & Debove] 271 pp.

Gutierrez, Perpetuo D. 1925. Nodosités juxta-articulaires, *Arch. Derm. Syphilol.* **12**: 159-170.

Guy, William H. 1920. Nocardiosis cutis resembling sporotrichosis, *Arch. Derm. Syphilol.* **2**: 137-143, *5 figs.*

Harbitz, Frances & Nils B. Grondahl. 1911. Actinomycosis in Norway: studies in the etiology, modes of infection and treatment, *Am. Jour. Med. Sci.* **142**: 386-395, *6 figs.*

Heckenroth, F. 1915. Au sujet des grains rouges d'un mycétome, *Bull. Soc. Path. Exot.* **8**: 624-629.

Helzer, J. 1930. Über einen aus menschlichen Auswurf stammenden menschen- und tierpathogenen Strahlenpilz, *Centralbl. Bakt.* I, **116**: 47-67.

Henrici, A. T. & E. L. Gardner. 1921. The acid-fast Actinomycetes with a report of a case from which a new species was isolated, *Jour. Infect. Dis.* **28**: 232-248.

Hertwig. 1886. Ueber den Actinomyces musculorum der Schweine, *Arch. Wiss. Prakt. Thierheilk.* **12**: 365-372, *Pl. 6.*

Hesse, G. 1892. Über Aktinomykose, *Deutsch. Zeitschr. Chirurg.* **34**: 275-307, *Pls. 11, 12.*

Hewlett, Richard T. 1892. On actinomycosis of the foot, commonly known as Madura foot, *Lancet* **2**: 18, 19.

—. 1893. Madura foot, *Lancet* **1**: 933.

—. 1893. On madura disease (mycetoma) of the foot, *Trans. Path. Soc. London* **44**: 172-177, *1 pl., 9 figs.*

Hintze, Hermann. 1924. Beitrag zur Ätiologie der Zungen-Aktinomykose des Rindes, *Arch. Wiss. Prakt. Tierheilk.* **51**: 480-498, *4 figs.*

Horst, Adolf. 1903. Ein Fall von Streptothrixpyaemia beim Menschen, *Zeitschr. Heilk. Abt. Path. Anat.* **24**: 157-176, *Pls. 13, 14.*

Howard, William Travis, Jr. 1904. A study of Actinomyces cultivated from commercial vaccine virus, *Jour. Med. Res.* **10**: 493-512.

Hübschmann, Karl. 1921. Über eine atypische Form von Aktinomykose, *Arch. Derm. Syphilis* **130**: 341-352.

*Hulphers, G. 1921. Undersokningar over notkreatursaktinomykosens atiologi, 2. *Nordiska Veterinarmotets Forhandlingar.* 6: 9.

Hummel, E. 1895. Zur Entstehung der Actinomykose durch eingedrungene Fremdkörper, *Beitr. Klin. Chirurg.* 13: 534-544.

Huntemuller. 1921. Streptotricheenerkrankungen, *Beitr. Path. Anat.* 69: 110-121.

Hyde, James Nevins & Nicolas Senn. 1896. A contribution to the study of mycetoma of the foot as it occurs in America, *Jour. Cut. Gen.-Urin. Dis.* 14: 1-15, *1 pl.*

Israel, J. 1878. Neue Beobachtungen auf dem Gebiete der Mykosen des Menschens, *Arch. Path. Anat. Physiol.* [Virchow] 74: 15-53.

Jamieson, Sydney. 1907. Streptothrix infections with special reference to the pulmonary form, *Australasian Med. Gaz.* 26: 16-23.

Jeanselme, Edouard. 1906. Des nodosités juxta-articulaires observées sur les indigènes de la presq'île IndoChinoise, *Arch. Schiffs-Tropenhyg.* 10: 5-16.

Jensen, H. L. 1931-1932. Contributions to our knowledge of the Actinomycetales II. The definition and subdivision of the genus Actinomyces with a preliminary account of Australian soil Actinomycetes, *Proc. Linn. Soc. N. S. Wales* 56: 345-370, *Pls. 19, 20.* III. Further observations on the genus Micromonospora, *Proc. Linn. Soc. N. S. Wales* 57: 173-180, 1932.

Joannidès, G., S. Papagheorghiou & Mlle. A. Angelo. 1931. Chronique de l'actinomycose en Grèce, *Bull. Soc. Path. Exot.* 24: 432.

Jolly, Robert. 1919. Sur une adénite à Nocardia ayant simulé un bubon pesteux, *Bull. Soc. Path. Exot.* 12: 60, 61. Also *Rev. Med. de l'Est.* 48: 42, 43, 1920.

Jones, C. Price. 1900. Preliminary note on cultures of Streptothrichiae from various sources, *Trans. Path. Soc. London* 51: 217-220.

Jordan, Arthur. 1930. Typische und atypische Akitinomycosisfälle, *Acta Derm. Venereol.* 11: 373-382, *3 figs.*

Jouenne. 1915. Un cas de mycétome à grains rouges, *Bull. Soc. Path. Exot.* 8: 623, 624.

Kanthack, A. A. 1892. Madura disease (mycetoma) and actinomycosis, *Jour. Path. Bact.* 1: 140-162, *Pls. 10-12.*

—. 1892. Madura disease of hand and foot, *Lancet* 1: 195.

Kapsenberg, G. 1923. Steenvorming onder invloed van schimmels tonsilsteen en speekselsteen, *Tijdschr. Vergelijk. Geneesk.* 9: 249-273, *8 pls.*

Karwacki, Léon. 1911. Fréquence des streptothricées dans des crachats tuberculeux, *C. R. Soc. Biol.* 66: 180, 181.

Kazda, Franz. 1920. Einiges über Aktinomykose, ihre Klinik und Therapie und neue therapeutische Bestrebungen, *Deutsch. Zeitschr. Chirurg.* 156: 312-377.

Khachaturian, Galitsakaia, Suteiev & Utenkov. 1933. Zur Frage der Streptotrichose der Haut, *Arch. Derm. Syphilis* 167: 585-594, *5 figs.*

Kischensky. 1899. Über Actinomyces-reinculturen, *Arch. Exp. Path. Pharm.* 26: 79-87, *Pl. 2.*

Kitt, Th. 1919. Akitinomykotische Brustfellentzündung beim Hunde, *Monatsh. Prakt. Tierheilk.* 29: 518-526, *6 figs.*

Klaber, Robert. 1933. Primary cutaneous Actinomycosis with a note on the Bacillus actinomycetem comitans, *Brit. Jour. Derm. Syphilis* 46: 12-19, *3 figs.*

Koch, Josef & Stutzer. 1911. Zur Biologie und Morphologie der Streptothrix Madurae, *Zeitschr. Hyg.* 69: 17-24.

Korté, W. E. de. 1918. Nocardia cylindracea; a South African otomycosis, *Ann. Trop. Med. Parasitol.* 11: 265-278, *Pls. 8, 9.*

Krantz & A. Tribout. 1895. Sur une forme d'invasion de l'actinomycose chez les boeufs africains, *Recueil Méd. Vét.* VIII, 2: 465-468.

Krause, Paul. 1899. Beitrag zur Kenntnis des Actinomyces, *Centralbl. Bakt.* 26: 209-212.

Lachner-Sandoval, Vincenzo. 1898. Über Strahlenpilze, *Inaug. Diss. Strassburg.* 75 pp., *1 pl.*

Langer, Joseph. 1904. Über Streptotricosis oesophagi bei einem 13-jährigen Knabe, *Zeitschr. Hyg.* 47: 447.

Langeron, Maurice. 1922. Actinomyces Salvati n. sp. nouveau Microsiphoné malgache, *Bull. Soc. Path. Exot.* 15: 526-533.

Langeron, Maurice & Paul Chevalier. 1912. Discomyces decusatus n. sp. champignon dermatophyte, *C. R. Soc. Biol.* 72: 1030, 1031.

*Lasserre, J. 1904. Contribution à l'étude du genre Nocardia (G. Streptothrix Cohn). Description d'une espèce nouvelle, *Thèse Univ. Toulouse.*

Laveran, A. 1906. Tumeur provoqué par un microcoque rose en zooglée, *C. R. Soc. Biol.* 61: 340, 341.

LeCalvé & H. Malherbe. 1899. Sur un Trichophyton du cheval à cultures lichenoïdes (Trichophyton minimum), *Arch. de Parasitol.* 2: 218-250.

—. 1899. Nouvelles recherches sur le Trichophyton minimum, *Arch. de Parasitol.* 2: 489-503.

—. 1900. Nouvelles observations de tondante causée par le Trichophyton minimum, *Arch. de Parasitol.* 3: 108-110.

Legrain, E. 1898. Sur quelques affections parasitaires observées en Algérie, *Arch. de Parasitol.* 1: 148-169, *8 figs.*

Lenhartz, Hermann. 1921. Ueber Lungenstreptotrichose, *Deutsch. Arch. Klin. Med.* 136: 129-142, *2 figs.*

Levy, E. 1899. Ueber die Actinomycesgruppe (Aktinomyceten) und die verwandte Bakterien, *Centralbl. Bakt.* 26: 1-11.

—. 1903. Die Wachstums- und Dauerformen der Strahlenpilze (Aktinomyceten) und ihre Beziehung zu den Bakterien, *Centralbl. Bakt.* 33: 18-23.

Lichterfeld. 1922. Ein Beitrag zur primären Lungenaktinomykose, *Deutsch. Med. Woch.* 48: 801, 802.

Liebmann, Vittorio. 1890. L'attinomice dell'uomo, *Arch. Sci. Med.* 14: 361-402, *3 figs.*

Liégard & Landrieu. 1911. Un cas de mycose conjonctivale, *Ann. d'Ocul.* 146: 418-426 [1912?].

Liénaux. 1909. Un cas d'actinomycose du cheval. Nodules sous-cutanées du chanfrein et adénite sous-glossienne, *Ann. Méd. Vét.* 58: 1-4.

Lieske, Rudolf. 1921. Die Morphologie und Biologie der Strahlenpilze, Leipzig, 292 pp., *4 pls.*

—. 1927. Allgemeines über Actinomyceten, *Handbuch Path. Mikroorg.* [Kolle & Wassermann, ed. 3] 5: 17-40, *12 figs.*

Lignières, J. 1924. Nouvelle contribution à l'étude des champignons produisant les actinomycoses, *Ann. Parasitol. Hum. Comp.* 2: 1-25.

Lignières, J. & G. Spitz. 1902. Contribución al estudio de las affecciones conocidasbajo el nombre de actinomicosis I, *Bol. Agric. y Ganaderia.*

—. 1902. Contribution à l'étude des affections connues sous le nom d'Actinomycose (Actinobacillose), *Rev. Soc. Méd. Argentina* 10: 5-105, *9 pls.*

—. 1904. Contribution à l'étude des affections connues sous le nom d'Actinomycose, II, *Arch. de Parasitol.* 7: 428-479, *Pl. 5.*

—. 1904. Contribution à l'étude, à la classification et à la nomenclature des affections connues sous le nom d'Actinomycose, *Centralbl. Bakt.* 35: 294-308, 452-458.

Lindenberg, Adolpho. 1909. Un nouveau mycétome, *Arch. de Parasitol.* 13: 265-282, *3 figs.*

Löhlein, M. 1909. Streptothrixpyämie nach primärer Bronchopneumonie, *Zeitschr. Hyg.* 63: 1-16, *Pl. 1.*

Löwenstein, Arnold. 1910. Zur Bakteriologie des Hornhautgeschwüres, *Klin. Monatsbl. Augenheilk.* N. F. 10: 185-207, *4 figs.*

Loghem, J. J. van. 1906. Zur Kasuistik der Streptothrixpyämie, *Centralbl. Bakt.* I, 40: 298-305, *2 figs.*

Lombardo-Pellegrino, Paolo. 1903. Di una Streptothrix isolata del sottosuolo, *Riforma Med.* 10: 1065-1068.

Lopez, Carlos Pasquini, see Pasquini Lopez, Carlos.

Lord, Frederick T. 1910. The etiology of actinomycosis. The presence of Actinomycetes in the contents of carious teeth and the tonsillar crypts of patients without actinomycosis, *Jour. Amer. Med. Assn.* 55: 1261-1263.

Lovejoy, Edward D. & R. W. Hammack. 1925. Mycetoma, report of four cases, *Arch. Derm. Syphilol.* 11: 71-79.

Lubarsch, O. 1899. Zur Kenntnis der Strahlenpilze, *Zeitschr. Hyg.* 31: 187-220, *Pl. 1, Figs. 11-19.*

Luginger, J. 1904. Streptotricheen als Ursache von Endocarditis beim Rinde, *Monatsh. Prakt. Tierheilk.* 15: 289-336, *6 figs.*

MacCallum, W. G. 1902. On the life history of Actinomyces asteroides, *Centralbl. Bakt.* 31: 528-547, *2 figs.*

McFadyean, J. 1889. The morphology of Actinomyces, *Brit. Med. Jour.* 1: 1339-1344.

Macfie, J. W. Scott. 1916. A fourth variety of Trichonocardiasis, with a note on the cultivation of Nocardia tenuis (Castellani, 1911), *Ann. Trop. Med. Parasitol.* 10: 283-289.

Macfie, J. W. Scott & A. Ingram. 1921. A fungus of the genus Nocardia cultivated from heart blood, *Ann. Trop. Med. Parasitol.* 15: 271-282.

Maier, Rudolf. 1909. Die Behandlung der Aktinomykose an der Wölflerchen Klinik und ihre Endergebnisse, *Beitr. Klin. Chirurg.* 63: 472-536.

*Maillet. 1837. Du farcin consideré dans l'espèce du boeuf, *Rec. Méd. Vét.* : 52.

Mantegazza, Umberto. 1924. Sopra un caso di Actinomicosi non comune del cuoio capelluto, *Giorn. Ital. Mal. Ven. Pelle* 65: 978-993.

Mare, Henri Louis. 1902. Sur quelques cas d'actinomycose en Lorraine, *Thèse Fac. Méd. Nancy* 13: 1-69.

*Marotta, R. A. 1904. Contribución al estudio de la actinomicosis y seudoactinomicosis en el hombre en la República Argentina, *Tesis, Buenos Aires.*

Martin, P. 1884. Pathologisch-anatomische Mittheilungen 5. Pneumonomykose vom Pferd, *Jahresber. K. Centr. Thierarzneischule in München* 1882-3: 111-115.

*Martinez y Lopez. 1918. *Repertorio Méd. Cirúrg.* 10:

Masia, Ausonio. 1925. Glossite cronica figurata superficiale con reperto culturale di Nocardia lingualis, *Giorn. Ital. Derm. Sifilol.* 66: 657-663.

*Mason, F. E. 1919. Pseudo-actinomycosis in the camel, *Agr. Jour. Egypt* 9: 7-13, *2 pls.*

Mazza, Salvador & Carlos Pasquini López. 1931. Micetoma podal actinomicósico observado en Tucumán, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 255-260, *6 figs.* [*6ta Reunión Soc. Argentina Patol. Regional del Norte, Salta,* 1930].

Mazza, Salvador, Hector Quintana & Miguel de los Ríos. 1931. Sobre un paramicetoma observado en Jujuy, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 6: 261-268, *8 figs.* [*6ta Reunión Soc. Argentina Patol. Regional del Norte, Salta,* 1930].

Mazza, Salvador & Rafael Villagran, 1932. Micetoma podal actinomicósico de tipo especial, nodular y larga evolución, *Reunión Soc. Argentina Patol. Regional del Norte en Tucumán* 7: 501-512, *11 figs.*

Mendel, Joseph. 1919. Cladothrix et infection d'origine dentaire (Cladothrix Matruchoti), *C. R. Soc. Biol.* 82: 583-586, *2 figs.*

Meyer, Kurt. 1934. Sur la genèse des massues des Actinomycètes, *C. R. Soc. Biol.* 115: 1684-1686.

Michmann, Julius. 1933. Über einen Fall von sog. primärer Actinomycose des Gehirns, *Inaug. Diss. Med. Fak. Ludwig-Maximilians Univ. München,* 39 pp.

Miescher, Guido. 1917. Ueber einen Fall von Mycetoma pedis nostras verursacht durch eine neue pathogene Streptothrix, nebst Bemerkungen zur Systematik der Trichomyzeten (Streptothrix, Actinomyzes), *Arch. Derm. Syphilis* 124: 297-442, *Pls. 20-25.*

Molaguero, Mariano E. 1932. Caso de micetoma podal actinomicósico observado en el norte santafecino, *Reunión Soc. Argentina Patol. Regional del Norte en Tucumán* 7: 472-479, *9 figs.*

Monestié, François. 1895. De l'actinomycose cutanée, *Thèse Fac. Med. Univ. Paris* 412: 1-75.

Montoya y Florez, J. B. 1904. Micetoma o pie Madura, *Ann. Acad. Med.* 12: 379-381.

Montpellier, J., A. Catanei & Lafranc. 1931. Un nouveau cas d'actinomycose de la face observé à Alger, *Bull. Soc. Path. Exot.* 24: 431.

Montpellier, J. & A. Lacroix. 1921. Encore un mycétome du pied, type ''pied de Madura'' observé en Algérie et dû au Nocardia Madurae, *Bull. Soc. Path. Exot.* 14: 357-359.

Montserrat, Carlos. 1932. Pseudomycetoma in the Philippines with report of one case, *Philippine Jour. Sci.* 49: 469-481, *Pls. 1-4.*

Morelli, E. 1930. Osservazioni sul polimorfismo delle streptotrichee, *Soc. Internaz. Microbiol.* 8: 52-59 [*Atti. Congr. Naz. Microbiol.* 2].

Moutier, François, Maurice Barbier & Deroche. 1925. Une mycose de l'inestin: la nocardose éléphantiasique et fistuleuse du rectum. Contribution à l'étude des rectites hypertrophiques ulcéreuses et sténosantes, *Arch. Malad. l'Appar. Dig. Nutrit.* 15: 173-187, *5 figs.*

Musgrave, W. E. & M. T. Clegg. 1907. The etiology of mycetoma; report of a case of the ochroid variety occurring in the Philippine Islands and caused by a new species of Streptothrix (*Streptothrix Freeri*), *Philippine Jour. Sci.* B. 2: 477-511, *Pls. 1-4.*

Naeslund, Carl. 1929. Experimentelle Übertragung der Aktinomykose vom Menschen auf Versuchstiere mittels Reinkulturen der Actinomycesform Wolff-Israel (Act. Israëli), *Acta Path. Microbiol. Scand.* 6: 66-77, *4 figs.*

—. 1929. Fortgesetzte Untersuchungen uber die Speichelsteinbildung unter besonderer Berücksichtigung primärer Speicheldrüsenactinomykose, *Acta. Path. Microbiol. Scand.* 6: 78-96, *2 figs.*

—. 1931. Experimentelle Studien über die Ätiologie und Pathogenese der Aktinomykose. *Acta. Path. Microbiol. Scand. Suppl.* 6: 1-156, *33 figs.*

Namysłowski, Boleslaw. 1910. O promieniowcach z ludzkiej rogówki. [Ueber die Actinomyceten aus der menschlichen Hornhaut], *Bull. Acad. Sci. Cracovie.* 1909: 2:418-426, *Pl. 21.*

—. 1912. Beitrag zur Kenntnis der menschlichen Hornhautbakteriose, *Centralbl. Bakt.* I, 62: 564-568.

Navarro, Horatio. 1918. Madura foot: report of a case, *Jour. Am. Med. Assn.* 71: 967, 968, *1 fig.*

Negroni, Pablo. 1930. Actinomyces y actinomycosis experimental, *Rev. Soc. Argent. Biol.* 6: 539-552.

—. 1931. Statistique de 157 cas de mycose étudiés à Buenos Aires, *C. R. Soc. Biol.* 108: 137, 138.

Neshchadimenko, M. P. 1908. Über eine besondere Streptothrixart bei der chronischen Eiterung des Menchen, *Centralbl. Bakt.* I, 46: 573-578, *1 pl.*

New, Gordon, B. & Fred A. Figi. 1922. Actinomycosis of the tongue, *Am. Jour. Med. Sci.* 163: 507-516.

—. 1923. Actinomycosis of the head and neck, a report of 107 cases, *Surg. Gyn. Obstet.* 37: 617-625.

Nicaud, P. 1928. Les formes actinomycosiques de l'Aspergillus fumigatus, *C. R. Soc. Biol.* 99: 1565-1567.

Niessen, van. 1896. Die Actinomyces-Reinkultur, *Arch. Path. Anat. Phys.* [Virchow] 150: 482-521, *Pls. 12-15.*

Niño, Flavio L. 1932. Consideraciones a proposito de tres observaciones de actinomicosis pleuropulmonar, *Reunión Soc. Argentina Patol. Reg. del Norte en Tucumán.* 7: 316-383, *7 pls., 46 figs.*

Nocard, E. 1888. Note sur la maladie des boeufs connue à la Guadeloupe sous le nom de farcin, *Ann. Inst. Pasteur* 2: 293-302, *Pls. 7, 8.*

Norris, Charles & John H. Larkin. 1900. Two cases of necrotic bronchopneumonia with Streptothrix, *Jour. Exp. Med.* 5: 155-193, *Pls. 11-16.*

*Norris, Subrahmanyan & Ganesh Rao. 1929. *Agric. Jour. India.*

Ochoterena, Isaac. 1926. Estudio de la Nocardia convoluta Chalmers y Christopherson, encontrada en el virus vacunal, *Rev. Mex. Biol.* **6**: 3-8, *10 figs.*

Ørskov, J. 1923. Investigation into the morphology of the ray fungi, *Communications de l'Institut Sérothérapique de l'Etat Danois.* **14**: 1-171 [also Thesis edition].

Ogata, M. 1908. Die Aetiologie der Rattenbisskrankheit, *Deutsch. Med. Woch.* **34**: 1099-1102; *Mitt. Med. Fak. Univ. Tokyo* **8**: 287-326, *Pls. 21-24,* 1909. II. *Mitt. Med. Fak. Univ. Tokyo* **9**: 343-357, *Pl. 20,* 1911; III. *Mitt. Med. Fak. Univ. Tokyo* **11**: 179-196, *Pl. 18,* 1914.

—. 1917. Achte Mitteilung über die Aetiologie der Tsutsugamushikrankheit, *Mittl. Med. Fak. Univ. Tokyo* **17**: 1-17, *Pls. 1, 2.*

*Oliver, Jaime H. 1907. La actinomicosis en el Uruguay. *Informe presentado al tercer congreso médico Latino-americano, Montivideo,* pp. 17-24.

*Orkalow. Zur Histologie der Aktinomykose, *Arkh. Vet. Med.* **1**: 47.

*Orlov, 1912. Actinomycosis of the cornea, *Vestnik Ophth.* **29**: 653.

Oxer, D. T. 1930. Mycotic dermatitis in sheep and green staining of wool, *Tasmanian Jour. Agr.* N. S. **1**: 120, 121, *2 figs.*

Pardo Castello, Vicente, Juan José Mestre & Gerardo Montejo. 1931. Actinomicosis. Algunas consideraciones sobre esta enfermedad en Cuba y relación de cuatro casos, *Bol. Soc. Cubana Derm. Sifiliogr.* **2**: 77-90.

Pasquini López, Carlos. 1923. Pie de madura o micetoma, *Semana Méd.* **30**: 629-633, *6 figs.*

—. 1927. Un caso de pie de Madura, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* **3**: 829-832 [*3ra Reunión Soc. Argentina Patol. Regional del Norte, Tucumán,* 1927].

Pavlovsky, A. & M. Matsutov. 1893. Sur la phagocytose dans l'actinomycose, *Ann. Inst. Pasteur* **7**: 544-549.

Peemoller, Fr. 1922. Über Lungenstreptotrichosen, *Beitr. Klin. Tuberkulose* **50**: 523-548.

Peisger, Franz Theodor. 1914. Ueber einen Fall von Aktinomykose der Haut, *Inaug. Diss. Med. Fak. Fr. Wilhelm's Univ.* Berlin, 31 pp.

Peña Chavarría, Antonio & Paul G. Shipley. 1927. A contribution to the study of mycotic warts, *Johns Hopkins Hosp. Bull.* **41**: 11-20, *7 figs.*

Petri, L. 1903. Ricerche sul genere Streptothrix Cohn, *Nuovo Giorn. Bot. Ital. N. S.* **10**: 585-601.

Petruschky, J. 1898. Demonstration von Präparaten und Kulturen von einem zweiten intra vitam diagnostizierten Fall von Streptotrichosis hominis, *Verhandl. Kongr. Inn. Med.* **16**: 557-561.

—. 1913. Die pathogenen Trichomyceten und Trichobacterin, Streptothrix, Cladothrix, Leptothrix, *Handb. Path. Mikroorg.* [Kolle & Wassermann] **5**: 267-300, *pl. 1.*

Piana, Gian Pietro. 1886. Actinomicosi incipiente. Actinomyces sviluppato alla superficie di frusti di tessuto vegetale fibrovasculare incistidati sotto la mucosa della lingua nei bovini, *Archivio Sci. Med.* **10**: 137-141, *Pl. 3, Figs. 1-3.*

Pijper, Adrianus. 1917. Some unusual infections, III *Nocardiasis. Med. Jour. S. Africa* **12**: 141, 142.

—. 1917. A case of nocardiasis, *Folia Microbiol.* **5**: 50-53, *1 pl.*

Pijper, Adrianus & B. Davidine Pullinger. 1927. South African Nocardiases, *Jour. Trop. Med. Hyg.* **30**: 153-156, *2 pls.*

Ping-Ting-Huang. 1933. Ueber einen Fall von dyshidrosiformer, oberflächlicher Hautactinomykose der Handteller und Fussohlen, *Derm. Woch.* **97**: 1679-1685, *2 figs.*

Pinoy, E. 1914. Les champignons des mycétomes, *Premier Congr. Internat. Path. Comp.* **2**: 210-218.

Plaut, Rahel. 1920. Über drei Fälle von Infektion mit echten, streng anaeroben Streptotricheen, *Centralbl. Bakt.* I, **84**: 440-449, *5 figs.*

Poehlmann, August. 1928. Erythrasma, *Handbuch Haut- Geschlechtskr.* [Jadassohn] **11**: 711-723, *4 figs.*

Poenaru, I. D. 1924. Présence du Streptothrix Nocardia dans certains abcès et ulcères sous-cutanés chez le chat, *C. R. Soc. Biol.* **91**: 749, 750.

Poncet, Antonin & Leon Bérard. 1904. À propos du diagnostic clinique de l'actinomycose humaine, *Arch. de Parasitol.* **8**: 548-557.

Potron, Maurice. 1914. Le Nocardia Dassonvillei est pathogène pour l'homme et les animaux, *Premier Congr. Internat. Path. Comp. 1912* **2**: 195-200.

Potron, Maurice & Georges Thiry. 1913. Pyodermatomycose provoquée par un Nocardia, *Rev. Med. de l'Est.* **45**: 159-170, 198-211.

Puntoni, V. 1930. Sur la pluralité des types de l'Actinomyces bovis, *C. R. Soc. Biol.* **103**: 303-305.

*—. 1930. Sulla pluralità dell'Actinomyces bovis Harz, *R. Accad. Med. Roma.*

—. 1930. Differenziamento morfologico di alcune specie di Attinomyceti confuse sotto la denominazione di Actinomyces bovis Harz, *Rendic. R. Accad. Naz. Lincei. Cl. Sci. Fis. Mat. e Nat.* **12**: 529-532.

—. 1931. Pluralità specifica dell'Actinomyces bovis, *Ann. Ig.* **41**: 1-28, *1 pl.*

—. 1931. Infestation des cultures de champignons par des acariens du genre Tarsonemus. Préservation de ces cultures, *Ann. Parasitol. Hum. Comp.* **9**: 359-362.

Putzu, F. 1924. Sopra un micetoma del piede osservato in Sardegna, *Arch. Ital. Chirurg.* **10**: 585-628.

*Rabe. 1888. Über einen neuentdeckten pathogenen Mikroorganismus beim Hunde, *Berl. Tierärztl. Wochenschr.*

*Ramazzotti, V. Del singolare reperto di un micete della specie actinomices bovis in un erpete circinnato, *Boll. Opera Pia Ambulanza G. Ronzoni.* **1**:

Ravaut, Paul & E. Pinoy. 1909. Sur une nouvelle forme de discomycose cutanée, *Ann. Derm. Syphiligr.* IV, **10**: 417-432.

Raynaud, M., J. Montpellier & A. Lacroix. 1922. Un cas de mycétome du pied à Nocardia madurae chez un indigène algérien, *Bull. Soc. Path. Exot.* **15**: 379-381.

Redaelli, Piero. 1928. Studii sulla Nocardiasi sperimentale Actinomycosi, Streptotrichosi. I. Infezione primaria, basi anatomiche e fattore cellulare della immunità naturale, *Boll. Ist. Sieroterapico Milanese* **7**: 75-101, 121-135, *Pls. 1-8.* II. Basi anatomiche e fattore cellulare della immunità acquista, *Ibid.* **7**: 239-265.

Reenstierna, J. 1926. Réproduction expérimentale du mycétome chez le lapin, *Arch. Inst. Pasteur Tunis* **15**: 101-107, *1 pl.*

Reina-Guerra, A. 1927. Mycétome actinomycosique à grains jaunes à San Salvador, *Ann. Parasitol. Hum. Comp.* **4**: 344-355, *13 figs.*

Remlinger, P. 1912. Un cas de pied de Madura observé au Maroc, *Bull. Soc. Path. Exot.* **5**: 707-709.

Ribeyro, Ramon E. 1919. Sobre un caso de micosis cutánea, *Anales Fac. Med. Lima.* **3**: 1-5, *1 pl.*

Ribordy, Jean. 1932. Contribution à l'étude de l'actinomycose pulmonaire chez l'enfant, *Thèse Fac. Med. Univ. Lausanne,* 53 pp.

Ridet, Gaston. 1911. Les Oospora, les oosporoses, *Thèse de Paris* **407**: 1-171.

Riehl, Gustav. 1884. Über Erythrasma, *Wien. Med. Woch.* **34**: 1209-1212, 1247-1250.

*Riising, J. 1921. [Actinomycosis of spine], *Ugeskr. Laeger. Kjøbenhavn* **83**: 883.

Rivière, P. 1896. Étude d'un nouveau Streptothrix parasite de l'homme, *Congr. Franç. Méd. Bordeaux.* **1895**: 2:1003-1011.

Rodella, A. 1920. Beitrag zum Studium der Aktinomykose, *Centralbl. Bakt.* I, **84**: 450-461, *8 figs.*

Roedelius, E. & E. Brack. 1926. Leptothrix-Mykose der Zunge, *Arch. Klin. Chirurg.* **141**: 1-13, *5 figs.*

Roger, Henri. 1909. Les oosporoses. I. Définition. Limites du groupe, les actinomycoses, les oosporoses et la tuberculose, *Presse Méd.* **17**: 433-435. II. Les oosporoses chez les animaux et chez l'homme. Formes cliniques des oosporoses humaines, *Ibid.* **17**: 449-452, *2 figs.*

—. 1921. Langue noire pileuse, *Gaz. Hôp. Civ. Milit.* 94: 1269, 1270.

Roger, Henri & L. Bory. 1909. Oosporose buccale, *Bull. Mém. Soc. Méd. Hôp. Paris* 27: 319-326.

—. 1909. Les oosporoses. I. Étude clinique, *Arch. Méd. Exp. Anat. Path.* 21: 229-254.

Roger, Henri, L. Bory & Antoine Sartory. 1909. Les oosporoses. II. Étude mycologique, *Arch. Méd. Exp. Anat. Path.* 21: 255-272, *6 figs.*

—. 1909. Note sur une nouvelle pathogène (Oospora pulmonalis), *C. R. Soc. Biol.* 66: 150-152.

—. 1909. Oospora buccalis, *C. R. Soc. Biol.* 66: 301-303.

Ronchese, Francesco. 1929. Primary actinomycosis of the skin, *Arch. Derm. Syphilol.* 20: 1-9.

Rosenbach. 1887. Über das Erysipeloid, *Arch. Klin. Chirurg.* 36: 346-359.

Rossi, Carmelita. 1905. Contributo alla conoscenza dello stipite Actynomices albus. Actynomices albus var. tossica, *Ann. Ig. Sperim.* 9: 693-708.

Rossi-Doria, Tullio. 1894. Su d'alcune specie di streptothrix trovate nell'aria studiati in rapporto a quella già note e specialmente all'Actinomyces, *Ann. Ist. Ig. Sperim. N. S.* 1: 399-438, *Pl. 8.*

Roth, Hans. 1921. Ein Fall von aktinomykotischem Leberabzess nach Appendicitis, *Zentralbl. Allg. Path.* 31: 340-345, *1 fig.*

Roussel, George. 1891. De l'actinomycose chez l'homme en France. Deux observations nouvelles, *Thèse Paris,* 72 pp.

Roy, L. G. 1922. Les mycoses bucco-pharyngées, *Jour. Méd. Paris* 41: 674, 675.

Ruffer. 1893. Pleomorphism of Actinomyces, *Lancet* 1: 933.

Ruiz Casabó, Manuel. 1894. Descripción de un Cladothrix cromógeno, *Crónica Méd. Quirúrg. Habana* 20: 340-343.

Rullmann, W. 1895. Chemisch- bakteriologische Untersuchungen von Zwischendeckenfüllungen mit besondere Berücksichtigung von Cladothrix odorifera, *Inaug. Diss. München,* 47 pp., *1 pl.*

—. 1898-1902. Über eine aus Sputum isolierte pathogene Streptothrix, *München. Med. Woch.* 45: 919-922, 1898. II. [with Fr. Perutz] *Ibid.* 46: 407-409, *1 fig.,* 1899. III. *Ibid.* 49: 925, 926, *2 figs.,* 1902.

*Sabrazès, Jean. 1896. Présence d'un Streptothrix dans trois cas de pyorrhée alveolo-dentaire, *Rev. Mens. Stomatologie.* :269.

Sabrazès, Jean & P. R. Joly. 1898. Sur un nouveau Streptothrix fréquemment isolé du vaccine de génisse, *C. R. Soc. Biol.* 50: 134, 135.

Sabrazès, Jean & P. Rivière. 1894. Sur un Streptothrix rencontré dans un cas d'abcés du cerveau et d'infarctus suppuré du rein, *Presse Méd.* 2: 302-304.

—. 1895. Les parasites du genre Streptothrix dans la pathologie humaine, *Semaine Méd.* 15: 383.

Sanfelice, Francesco. 1895. Über einige Infektionskrankheiten der Haustiere in Sardinien. Zoopathologische Untersuchungen, *Zeitschr. Hyg.* 20: 1-30, *Pls. 1-3.*

—. 1896. Beiträge zur Kenntnis der Aktinomykose der Leber bei den Rindern, *Arch. Wiss. Prakt. Thierheilk.* 22: 153-170, *Pls. 2, 3.*

—. 1904. Über die pathogene Wirkung einiger Streptothrix (Actinomyces) Arten, *Centralbl. Bakt.* 36: 355-367.

—. 1905. Streptothrix-Pseudotuberkulose, *Centralbl. Bakt.* 38: 30-41, *1 pl.*

—. 1921. Intorno alle mutazione che presenta Streptothrix acido resistente nell'organismo animale, *Boll. Ist. Sieroterapico Milanese* 2: 1-15.

—. 1922. Streptothrix Actinomyces cuniculi. Una streptotricea che negli animali de esperimento si presenta con colonie raggiate, *Boll. Ist. Sieroterapico. Milanese* 2: 327-333.

—. 1933. Ueber einige pathogene Variationen der Streptothrix carnea, *Centralbl. Bakt.* I, 130: 228-234, *6 figs.*

Sanford, Arthur H. & Thomas B. Magrath. 1922. Etiology and laboratory diagnosis of actinomycosis, *Minn. Med.* **5**: 71-80, *4 figs.*

Santillán, Prudencio & Gerardo Palacios. 1927. Discomicosis de la pierna, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 3: 825-828 [*3ra Reunión Soc. Argentina Patol. Regional del Norte, Tucumán* 1927].

Sartory, Antoine. 1910. Sur les caractéristiques du genre Oospora et son extension dans l'état actuel de nos connaissances, *Presse Méd.* 577-579.

—. 1910, 1911. Contribution à l'étude de quelques Oospora pathogènes, *Bull. Soc. Myc. France* **26**: 394-403, 1910; **27**: 160-171, 1911.

—. 1916. Étude d'un Oospora pathogène nouveau "Oospora bronchialis n. sp.," *Bull. Sci. Pharmacol.* **23**: 12-19, *1 pl.*

—. 1916. Étude d'un oospora acido résistant Oospora pumonalis variété acido-résistant, *Arch. Méd. Pharm. Milit.* **65**: 604-609.

—. 1920. Oosporoses rénales, *Rev. Méd. de l'Est.* **48**: 20-25.

Sartory, Antoine, M. Meyer & J. Meyer. 1930. Contribution à l'étude des mycoses osseuses; trois cas d'ostéites dues d'une part à l'Actinomyces asteroides (Eppinger) et d'autre part à l'Hemispora stellata, *Ann. Inst. Pasteur* **44**: 298-329, *8 figs.*

Sartory, Antoine & R. Sartory. 1925. Deux cas d'oosporoses pulmonaires guéries, provoquées par un champignon du genre "Actinomyces" (Oospora), *Bull. Acad. Méd.* [Paris] III, **94**: 893, 894.

Sartory, Antoine, R. Sartory & Jacques Meyer. 1930. Contribution à l'étude des mycoses osseuses primitives: Un nouveau cas d'actinomycose osseuse à grains jaunes sans massues, *Bull. Acad. Méd.* [Paris] III, **104**: 243-246.

—. 1931. Étude du parasite isolé d'un cas d'actinomycose tibiotarsienne à grains jaunes, *C. R. Soc. Biol.* **106**: 212-214.

—. 1931. Une microsiphonée à pigment rouge isolée de glandes sous-maxilaires, *C. R. Soc. Biol.* **108**: 1186-1188.

—. 1931. Étude d'un Actinomyces isolé d'expectorations chez une femme suspecte de tuberculose pulmonaire, *C. R. Soc. Biol.* **108**: 1188-1190.

—. 1933. Le cycle évolutif des Actinomyces dans les cultures après passage à travers l'ultrafiltre de collodion, *C. R. Acad. Sci.* **197**: 1465-1467.

Sauvageau, Camille & M. Radais. 1892. Sur les genres Cladothrix, Streptothrix, Actinomyces et description de deux Streptothrix nouveaux, *Ann. Inst. Pasteur* **6**: 242-273, *Pl. 9.*

Schabad, J. A. 1904. Actinomycosis atypica pseudotuberculosa, *Zeitschr. Hyg.* **47**: 41-80, *Pl. 3.*

Scheele & J. Petruschky. 1897. Kulturen und Präparate einer Menschenpathogenen Streptothrixart, *Verhandl. Kongr. Inn. Med.* **15**: 551-553.

Schlange, H. 1892. Zur Prognose der Aktinomykose, *Arch. Klin. Chirurg.* **44**: 863-875.

Schlegel, M. 1913. Aktinomykose, *Handb. Path. Mikroorg.* [Kolle und Wassermann] **5**: 301-364, *illus.*

—. 1927. Strahlenpilzkrankheit. Aktinomykose, *Handb. Path. Mikroorg.* [Kolle & Wassermann, ed. 3] **5**: 41-112, *20 figs.*

Schmorl, Georg. 1891. Über ein pathogenes Fadenbacterium (Streptothrix cuniculi), *Deutsch. Zeitschr. Thiermed. Vergleich. Path.* **17**: 375-408, *Pls. 7, 8.*

Schottmüller, H. 1914. Zur Ätiologie und Klinik der Bisskrankheit (Ratten-Katzen-Eichhörnchen-Bisskrankheit), *Derm. Woch.* **58**: Ergänzungsheft :77-103, *2 pls., 4 figs.*

Scott, W. M. 1922. Bovine actinomycosis, its pathogenesis and treatment by vaccines, *Brit. Med. Jour.* **2**: 1163, 1164.

Serra, Giovanni. 1926. Infezioni sperimentali da Actinomyces carneus, *Sperim.* **70**: 251-278, *2 pls.*

*Setti, Carlo. 1929. Discomycosi di Rivolta (actinomycosi di Harz) Studio storico, morfologico fisiologico, *Giorn. Batter. Immunol.* **4**: 1-96, *48 figs.*

Shiota, H. 1909. Beitrag zur Kenntnis der menschlichen Aktinomykose (Klinische und bakteriologische Studie), *Deutsch. Zeitschr. Chirurg.* **101**: 289-401, *11 figs.*

Silberschmidt, W. 1899. Sur un nouveau Streptothrix pathogène (Streptothrix caprae), *Ann. Inst. Pasteur* **13**: 841-853.

—. 1900. Ueber zwei Fälle von Pilzmassen im inneren Thränenkanälchen, *Centralbl. Bakt.* **27**: 486-493, *1 pl.*

—. 1901. Ueber Actinomykose, *Zeitschr. Hyg.* **37**: 345-380, *Pls. 3, 4.*

Silva Araujo. 1928. Estudo anatomo-pathologico de um caso de actinomycose humana, *Sciencia Med.* **6**: 125-131, *7 figs.*

Silva, Flaviano. 1929. Contribuicão para o estudo do mycetoma podal na Bahia, *Sciencia Med.* **7**: 153-164, *6 figs.* [rev. *Brasil Med.* **43**: 635, 636.]

Smith, Theobald. 1918. A pleomorphic bacillus from pneumonic lungs of calves simulating Actinomyces, *Jour. Exp. Med.* **28**: 333-344, *Pls. 25-28.*

—. 1921. The etiological relation of Bacillus actinoides to bronchopneumonia in calves, *Jour. Exp. Med.* **33**: 441-469, *Pls. 42-50.*

Solari, Emilio F. 1917. Primer caso de micetoma o pie de madura observado en Rosario de Santa Fé, *Semana Méd.* **24**: 573-582, *7 figs.*

*Sommer, Baldomero & Nicolas V. Greco. 1904. Primer caso de micetoma o pie de madura en la républica Argentina, *Argentina Méd.* [Segundo congreso médico latino-americano, Buenos Aires].

Souza-Araujo, H. C. de. 1929. Essais de culture du Mycobacterium leprae (Coccothrix leprae Lutz 1886). Isolement à partir d'un léprome d'un Actinomyces, Actinomyces lepromatis n. sp., *C. R. Soc. Biol.* **100**: 937-939.

Speroni, David and Joaquín Llambías. 1930. Actinomicosis generalizada, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* **5**: 357-361, *1 fig.* [*5ta Reunión Soc. Argentina Patol. Regional del Norte, Jujuy,* 1929.]

Steele, Albert. 1924. A Streptothrix organism from a brain abscess, *Jour. Med. Res.* **44**: 305-310.

Sternberg, Carl. 1900. Zur Kenntnis des Aktinomycespilzes, *Wien. Klin. Woch.* **13**: 548-551.

—. 1931. Zur Kenntnis der Aktinomykose des Gehirns, *Zeitschr. Hyg.* **113**: 151-159.

Steyn, D. G. 1931. Investigations into the cause and transmission of lumpy wool affecting merino sheep and its treatment, *Rept. Dir. Vet. Serv. and Animal Industry, Union of South Africa* **17**: 1:205-213, *6 figs.*

Stokes, William Royal. 1904. A study of the group Actinomyces with the report of a pathogenic species for man, *Am. Jour. Med. Sci.* **128**: 861-875, *4 figs.*

Sutton, Richard L. 1913. Mycetoma in America, *Jour. Amer. Med. Ass.* **60**: 1339-1342.

Talice, Rodolfo V. 1927. Actinomicosis en el Uruguay, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* **3**: 819-824, *1 pl.* [*3ra Reunión Soc. Argentina Patol. Regional del Norte, Tucumán* 1927.]

—. 1932. Sur quelques champignons parasites du genre Actinomyces Harz isolés à Montivideo, *C. R. Soc. Biol.* **109**: 144-146.

Tarozzi, Giulio. 1909. Ricerche anatomopatologiche, batteriologiche e sperimentali sopra un caso di actinomicosi del piede, *Archivio per le Sci. Med.* **33**: 553-632, *15 figs.* [**Thesis Univ. Modena.*]

Tempsky, Arthur V. 1927. Resultate der Röntgentherapie bei der Strahlenpilzerkrankung, *Beitr. Klin. Chirurg.* [Bruns] **139**: 207-216.

Terni, C. 1894. Eine neue Art von Actinomyces (Actinomyces Gruberi), *Centralbl. Bakt.* **16**: 362, 363.

Thiriet, L. 1919. Contribution à l'étude des Oospora et des Oosporoses, *Thèse Doct. Pharm. Nancy,* II, **56**: 1-132.

—. 1920. Oosporose buccopharyngée, *Rev. Méd. de l'Est* **48**: 26-30.

Thiroux, A. 1906. Mycose de la jambe dû au Streptothrix Madurae, *Ann. Hyg. Méd. Colon.* **9**: 453-455.

Thiroux, A. & J. Pelletier. 1912. Mycétome à grains rouges de la paroi thoracique. Isolement et culture d'une nouvelle Oospora pathogène, *Bull. Soc. Path. Exot.* 5: 585-589.

Thiry, Georges. 1897. Contribution à l'étude du polychromisme bactérien—bacille et Cladothrix polychromes—cristaux colorés, *Arch. Physiol. Norm. Path.* V, 9: 283-288, *1 fig.*

—. 1900. Bacille polychrome et Actinomyces mordoré. Recherches biologiques sur les bactéries bleues et violettes. Polychromisme. Corps bactériens et cristaux colorés. Matière colorante cristallisée, *Trav. Lab. Hyg. Inst. Sérothérapique Univ. Nancy,* 153 pp., *7 pls.*

Thjøtta, T. & E. Gundersen. 1925. A Streptothrix isolated from the blood in a case of acute rheumatism, with remarks upon the classification of ray fungi, *Jour. Bact.* 10: 1-12, *9 figs.*

Toole, H. 1931. Die Madurafusserkrankung in Griechenland, *Deutsch. Zeitschr. Chirurg.* 232: 78-91, *4 figs.*

Torres, Octavio. 1916. Observacão de um caso de actinomycose: 2° caso observado na Bahía, *Brasil Med.* 30: 225-228.

—. 1919. Um caso de actinomycose cervico-facial, *Brasil Med.* 33: 361-363.

Trolldenier. 1903. Ueber eine bei einem Hunde gefundenen Streptothrix, *Zeitschr. Tiermed.* 7: 81-109, *9 figs.*

Tsiklinsky. 1903. Sur la flore microbienne thermophile du canal intestinal de l'homme, *Ann. Inst. Pasteur* 17: 217-240.

Tunnicliff, Ruth. 1916. Streptothrix in bronchopneumonia of rats similar to that in rat-bite fever, *Jour. Infect. Dis.* 19: 767-772, *3 pls.*

Tunnicliff, Ruth and Leila Jackson. 1930. Vibriothrix tonsillaris n. s., the organism of actinomyces-like tonsillar granules, *Jour. Infect. Dis.* 46: 12-17, *Pls. 1, 2.*

Tusini, Giuseppe. 1900. Ueber die Actinomykose des Fusses, *Arch. Klin. Chirurg.* 62: 249-287, *Pls. 3-7.*

Unna, P. G. 1897. Ueber Aktinomykose und Madurafuss, *München. Med. Woch.* 44: 150 [*Deutsch. Med. Zeitung* 18: 49-51, 1897].

Unna, P. G. & Ernst Delbanco. 1900. Beiträge zur Anatomie des indischen Madurafusses (Mycetoma, Fungus disease of India), *Monatsh. Prakt. Derm.* 31: 545-567, *Pls. 3, 4.*

Vallée, H. 1903. Sur un nouveau Streptothrix (Streptothrix polychromogène), *Ann. Inst. Pasteur* 17: 288-292.

Vera, José E., Donato Vívoli & Remigio Consiglieri. 1932. Sifilis y actinomicosis pleuropulmonar, *Reunión Soc. Argentina Patol. Regional del Norte en Tucumán* 7: 296-315, *12 figs.*

Veszprémi, D. 1907. Zuchtungs- und Tierversuche mit Bacillus fusiformis, Spirochaete gracilis und Cladothrix putridogenes. Beiträge zur Bakteriologie und Histogenese der experimentellen gangränosen Entzündungen, *Centralbl. Bakt.* I, 44: 408-415, 515-523; 45: 15-33, *1 pl.*

*Vincent E. and H. Soulié. 1905. Quelques cas de maladies à Streptothrix chez l'homme en Algérie, *Bull. Méd. d'Alger.*

Vincent, H. 1894. Étude sur le parasite du pied de Madura, *Ann. Inst. Pasteur* 8: 129-151.

Vuillemin, Paul. 1904. Nécessité d'instituer un ordre des Siphomycètes et un ordre de Microsiphonées, parallèles à l'ordre des Hyphomycètes, *C. R. Acad. Sci.* 138: 219-221.

—. 1908. Sur l'utilité du groupe des Microsiphonées, *C. R. Soc. Biol.* 64: 1042, 1043.

Waksman, Selman A. 1918. Studies in the metabolism of pathogenic Actinomyces (Streptothrices) I, *Jour. Infect. Dis.* 23: 547-554.

Warthin, Aldred Scott & Herbert S. Olney. 1904. Pulmonary streptothricosis, *Amer. Jour. Med. Sci.* 128: 637-649, *3 figs.*

Waters, R. 1932. Mycotic dermatitis in sheep, *N. Zealand Jour. Sci. Techn.* 13: 309, 310, *1 fig.*

Weidman, Fred D. 1928. The affinities between black tongue and trichomycosis, *Arch. Derm. Syphilol.* 18: 647-665.

White, Paul A. 1923. Actinomycosis; diagnosis and treatment, *Jour. Iowa State Med. Soc.* 13: 105-107.

*Wilbert. 1908. Erythasma d'origine parasitaire chez le cheval, *Recueil d'hyg. Méd. Vét. Militaire.*

Williamson, G. A. 1905. Interesting case of mycetoma in Cyprus, *Jour. Trop. Med. Hyg.* 8: 81.

Wissmann, Wilhelm. 1931. Ueber Ergebnisse der Röntgenbestrahlung bei pyogenen Entzündungen und der Aktinomykose in der Kopf- und Halsgegend, *Inaug. Diss. Med. Fak. Albertus Univ. Koenigsberg Pr.*, 27 pp.

Witter, Paul. 1933. Beiträge zur Kenntnis der Aktinomyceten, *Inaug. Diss. Math. Naturw. Fak. Univ. Göttingen*, 20 pp.

Wohl, Michael G. 1923. Fungous diseases of man in the State of Nebraska. Sporotrichosis, blastomycosis, actinomycosis, *Trans. Sect. Path. Physiol. Am. Med. Ass.* 74: 26-45, *10 figs.* [condensed *Jour. Am. Med. Ass.* 81: 647-653, *10 figs.*].

Wolff, Max & James Israel. 1891. Ueber Reinkulturen des Aktinomyces und seine Uebertrāgbarkeit auf Thiere, *Arch. Path. Anat. Physiol.* [Virchow] 126: 11-59, *Pls. 1-8.*

Wright, James Homer. 1905. The biology of the organism of actinomycosis, *Jour. Med. Res.* 13: 349-404, *Pls. 24-33* [reprinted *Publ. Massachusetts Gen. Hosp. Boston,* 1905].

Zeisler, Joseph. 1906. Notes on a case of Actinomycosis, *Trans. Amer. Derm. Ass.* 1906: 104-107.

*Zschokke. 1888. Doppelfärbung von Strahlenpilzen, *Schweiz. Arch. Thierheilk.* 30: 81.

Zur Nedden. 1907. Ueber Infektionen des Auges mit Streptotricheen, *Klin. Monatsbl. Augenheilk.* N. F. 3: 152-158, *1 fig.*

CHAPTER XXI

SPOROTRICHEAE

Mycelium branched, septate; spores unicellular, usually solitary, never in chains, borne either on very short and little differentiated sterigmata along the hyphae or sessile. Conidiophores wholly undifferentiated.

The genera included here are often included in a larger group, the Botrytideae, in which the conidiophore is variously branched. These genera form a transition from the highly developed blastospores and arthrospores of the Eremascaceae Imperfectae to the better known genera of Hyphomycetes in which the conidia are borne on specialized conidiophores. Vuillemin sought to place in a separate group, those species in which there seems to be little or no provision for the separation of the conidium from the conidiophore, naming the group Aleurismeae from the genus *Aleurisma*, and calling such spores aleurospores instead of conidia. For the most part, his Aleurismeae have already been discussed in the Gymnoascaceae Imperfectae. There are still a few forms, in which the mycelium is wholly uninucleate, which grow in the horny layer of the epidermis. It is possible that they represent a stage in the life cycle of some of the dermatophytes, but none of the species have been adequately studied. The other genera, *Acremonium*, *Acremoniella, Sporotrichum*, and *Trichosporium*, are all found in the subcutaneous tissues or in the internal organs. Most species in these genera are saprophytic on decaying vegetable matter. The whole group badly needs monographic study.

Key to Genera

Conidia or aleurospores sessile on the mycelium, depending on the death of the mycelium for liberation.
  Mycelium and spores white or light colored; found in the horny layer of the epidermis. *Aleurisma.*
  Mycelium and spores black. *Trichosporium.*
Conidia usually on short sterigmata, not in the horny layer of the epidermis.
  Conidia terminal on short, simple, lateral branches.
    Conidia hyaline or bright colored. *Acremonium.*
    Conidia black or dark brown. *Acremoniella.*
  Conidia on long sterigmata, lateral on somewhat branched conidiophores. *Rhinotrichum.*
  Conidia on short, simple hyphae or lateral or terminal, on short branches. *Sporotrichum.*

ALEURISMA

Aleurisma Link, Mag. Ges. Naturf. Freunde Berlin **3**: 18, 19, 1809.
Blastomyces Costantin & Rolland, Bull. Soc. Myc. France **4**: 153-157, 1888.
Aleurophora Magalhães, Brasil Med. **30**: 369, 370, 1916.

The type species is *Aleurisma sporulosum* Link.

This genus was first described by Link as follows:

18 *Aleurisma. Thallus e floccis ramosis, septatis, densissime intertextis. Sporidia inspersa, minuta, globosa.*

Thallus initium Boleti seu Poriae refert at sporidiis creberrimis immixtis genus declarat. E floccis valde contextis, persistentibus constat, ita ut pannulum fere sistat. Sporidia intra thallum conglomerata. Unica species nondum descripta.

Al. sporulosum, caespitibus indeterminatis crassis densis albis. Caespitis ad 2-4 linneas latos, ad lin. fere crassos format in ramis dejectis Nudo oculo massam farinosam continere videtur. Et e Lusitania habemus. Iconem v. fig. 25.

The figure does not help in the interpretation of the above, as it shows only flexuous tangled nonseptate hyphae and a mass of unattached spores.

Nees von Esenbeck, *Das System der Pilze und Schwämme* 51, 1816, described *Aleurisma erubescens* as new.

Martius, *Flora Cryptog. Erlangensis* 335, 1817, described *Aleurisma granulosum* as new.

In 1818, Link reduced *Aleurisma* to *Sporotrichum* and moved part of the original species of *Sporotrichum* to *Alytosporium.*

In 1836, Chevallier in his *Flore générale des environs de Paris,* ed. 2, 1: 51, reestablished *Aleurisma,* recognizing five species: *A. erubescens, A. sporulosum, A. bulborum, A. saccharinum,* and *A. flavissimum.* Of these, only *A. sporulosum* was described by Link when he first established the genus and must be taken as the type. Other authors, in general, ignored the work of Chevallier until the genus was taken up by Vuillemin in 1911. A careful study of the mechanism of spore development in *A. flavissimum* led him to redefine the genus as recognized at present. Vuillemin also reduced *Blastomyces luteus* Costantin & Rolland, the type of *Blastomyces,* to synonymy with *A. flavissimum.*

Hyphae repent, septate, branched; aleurospores intermediate between chlamydospores and true conidia, not provided with a well-developed mechanism for spore discharge, but depending on the disintegration of the supporting cells in the mycelium; spores unicellular, fairly thick-walled.

Saprophytic, often on dung, very rarely parasitic. Some are inclined to place the greater portion of the dermatophytes here, but it should be noted that the mycelial cells are wholly uninucleate in *Aleurisma* while they are multinucleate in a relatively large portion of the life cycle in the dermatophytes. Very few of the pathogenic species referred here have been well described, and still fewer have been carefully studied. It is possible that some of the species reported as growing in the horny layer of the epidermis belong in the dermatophytes. *Aleurophora* has also been referred here for want of information to place it elsewhere.

Key to Species

Aleurospores elongate, coremia present.	
Colonies salmon color.	*A. salmoneum.*
Colonies white, elevated.	*A. dermatitidis.*
Colonies brown.	*A. albiciscans.*
Aleurospores ovoid to spherical.	
From patches of scaling with slight pruritus.	*A. benigna.*
From vesico pustules.	*A. lugdunense.*
	A. Vuillemini.

Aleurisma salmoneum Vuillemin, C. R. Acad. Sci. **189**: 407, 1929.

A laborer in wine vaults showed on the anterior face of the right arm a pustule, about 1 cm. in diameter, which had been the seat of a slight but incessant suppuration for about a month. On pressure, lesion exuded a thin pus, whose granules showed neither spores, grains, nor filaments.

Cultures salmon color. If inoculation is deep, the surface of the agar is smooth and mammillate; if superficial, the colonies are dull, rough, with a deeper color. Aleurospores terminal, 4 × 2.3—10.5 × 4μ.

Aleurisma albiciscans (Nieuwenhuis) Dodge, n. comb.

Trichophyton albiciscans Nieuwenhuis, Geneesk. Tijdschr. Nederl. Indie **48**: 35-51, *Pls. 1-3*, 1908; Arch. Derm. Syphilis **89**: 3-30, *Pls. 1-4*, 1908.

Atrichophyton albiciscans Castellani & Chalmers, Man. Trop. Med. ed. 3, 1008, 1919.

Glenospora albiciscans Ota, Ann. Parasitol. Hum. Comp. **3**: 79-84, *1 fig.*, 1925.

Glenosporella albiciscans Nannizzi apud Agostini, Atti Ist. Bot. R. Univ. Pavia, IV, **2**: 98, 1930 [1931].

Found in tinea albigena. On soles or palms, little itching nodules appear. These become vesicles 3-4 mm. in diameter, at first filled with an amber colored liquid, then purulent and drying. In time, these vesicles are more frequent and larger, followed by drying and keratinization. The epidermis becomes very thin and easily torn, so that secondary infections frequently occur. Finally, pigment is lost over the infected areas, which have expanded to include the lower arms and legs. This disease is widespread in the interior of Java, Borneo, and Lombok, probably also in New Guinea and Sumatra.

Mycelium of young cultures slender, 2μ in diameter, guttulate, cells 15-20μ long, spherical or ovoid or elongate. Occasional lateral spores with or without pedicel. In older cultures, spores more or less ovoid, 1-1.5μ in diameter, lateral with or without pedicel. No thyrses present—Nieuwenhuis. Hyphae 2-3μ, rarely 3-5μ, in diameter, walls thin, covered with very fine rugosities. Intercalary spores present, 7-10μ in diameter, coremium branching either perpendicular or at an acute angle to the hyphae. Conidiophores simple or irregularly branched, no verticils present. Aleurospores terminal or lateral, usually sessile on conidiophore, usually solitary, occasionally in groups of two to three, 2-3 × 2-7μ, thin-walled, not filled with granules. Very rarely there is a suggestion of thyrses, but these are not well developed as in *Microsporum*. Coremia bearing numerous aleurospores and chlamydospores usually are present.

Growth is slow, attaining a diameter of only 10 mm. in 21 days on the first isolation. On Sabouraud agar, there forms an irregularly rounded disc, 4-6 cm. in diameter, after 42 days, clear chamois color in malt agar, coarse velvety with numerous small coremia, 1-3 mm. long in center. As cultures dry, medium becomes horny, white, with aerial mycelium appearing. Development good on potato.

Aleurisma dermatitidis (Agostini) Dodge, n. comb.

Glenosporella dermatitidis Agostini, Atti Ist. Bot. R. Univ. Pavia, IV, **2**: 93-101, *4 figs.*, 1930 [1931].

[Case of Mantarro?* Giorn. Ital. Derm. Sifilol. **72**: 131-143, 1931.]

Heads sparse, suborbicular, minute or confluent in larger colonies, irregularly subrotund and raised above the substrate, white without, yellow within. Hyphae hyaline, densely interwoven, simple or irregularly branched, continuous or septate, variously granulose 2-7μ in diameter. Aleurospores hyaline, spherical or subrotund, thick-walled 7-10 × 4-7μ, clinging to the branches of mycelium, acrogenous, solitary or irregularly disposed, sessile or on aleurophores of varying length. Arthrospores rounded or oblong or irregular, 4-15μ in diameter, intercalary, catenulate.

Aleurisma benigna (Magalhães) Vuillemin, Champ. Paras. Mycoses Homme 114, 1931.

Aleurophora benigna Magalhães, Brasil Med. **30**: 369, 370, 1916.

Isolated from circular patches of scaling with slight pruritus, infection scarcely noted by patient until attention was called to it by physician. Fungus most abundant in the stratum disjunctum of the epidermis.

Mycelium curved, long or short, dichotomous, 2-3μ in diameter. Reproduction mainly by arthrospores (thallospores), 2-3μ in diameter, or by aleurospores. Yeast cells spherical to ovoid, 2-5μ in diameter.

Cultures mentioned but not described at all in this place. Genus not described. No figures.

Aleurisma lugdunense Vuillemin apud Massia & Grigorakis, C. R. Soc. Biol. **91**: 1381-1383, 1924.

Scales of erythremato-squamous lesion with peripheral vesicopustules on internal face of knee where skin was kept moist by prosthetic apparatus.

Mycelium yellow, with some racquet cells, aleurospores as in *Sporotrichum* 3-4 × 2-2.5μ; chlamydospores 5-6μ. Aleurospores germinate with 1-3 germ tubes, chlamydospores with 1-4. All cells uninucleate except rapidly growing terminal cells, which may have as many as four nuclei.

Colonies café-au-lait in color, smooth becoming powdery white.

Baudet (1930) studied a lesion on a dromedary, in which the organism was identified by Vuillemin as this species along with *Grubyella Langeroni*. Baudet describes the cultural characters of his organism as follows: Aleurospores 1-2.5 × 0.8-1.5μ, ovoid, borne singly on short branches as in *Monosporium*. He failed to find the chains of aleurospores reported by Massia. The chlamydospores were mistaken for racquet cells. Produced a diffusing pigment on glucose media, rose, then wine red, which disappeared in subcultures, apparently developed on acid media pH 4.4-4.6, while it was greenish yellow on more alkaline media. Reverse honey yellow (melleus of Saccardo *Chromotaxia*).

There seems to be little to differentiate the following species from this, but both the original descriptions are too poor for certain identification.

Aleurisma Vuillemini, Grigorakis, Fayet & Magrou, C. R. Soc. Biol. **95**: 649-651, 1926.

From lesions in dog similar to those caused by *Microsporum canis.*

Aleurospores 2-4.5 × 2.3μ, spherical to ovoid, germinating with 1-3 germ tubes. Whole cycle uninucleate as far as observed.

At first smooth, café-au-lait, then white. On liquid media, a ring and thick pellicle with white surface and café-au-lait color below. On malt gelatin, a red pigment in stripes or patches is produced and medium liquefied, the whole then becoming chocolate colored.

Doubtful Position

The following incompletely described species probably belong here but may belong in the imperfect Eremascaceae. They do not belong in *Glenospora* by any definition current in mycology or medical literature.

Aleurisma metaeuropeum (Castellani) Dodge, n. comb.

Glenospora metaeuropea Castellani, Med. Press Circular **136**: 440, 1933; Jour. Trop. Med. Hyg. **36**: 309, 310, *Figs. 30-33,* 1933.

Originally isolated from a case of dermal blastomycosis contracted in the Balkans. Later isolated from a woman in Italy following an injection of camphorated oil in the buttock, which produced ulcers that extended slowly, causing large cavities with granulomatous margins and finally affecting the sacrum and some vertebrae. Cured by prolonged treatment with massive doses of potassium iodide.

Hyphae septate, 2-6μ in diameter, aleurospores terminal, subspheric, 6-10μ, or ovoid, 8.4 × 3.5μ.

On glucose agar, colonies white and fluffy. No pigmentation of mannitol agar. No fermentation or acid production with carbohydrates, no action on milk. Gelatin liquefied.

Aleurisma metamericanum (Castellani) Dodge, n. comb.

Glenospora metamericana, Castellani, Jour. Trop. Med. Hyg. **36**: 310, 311. *Fig. 34,* 1933.

''Blastomycosis.''

Hyphae septate, 1.7-2μ intercalary chlamydospores occasional; lateral aleurospores spherical or ovoid, 3-6μ in larger diameter.

On glucose agar, growth sometimes moist, center vermiculate with furrows. No pigmentation on mannitol agar, gelatin liquefied promptly.

Perhaps this species should be placed in *Proteomyces,* but it is too poorly described to place it definitely.

Aleurisma breve (Castellani) Dodge, n. comb.

Glenospora brevis Castellani, Jour. Trop. Med. Hyg. **36**: 311, *Fig. 35,* 1933.

Isolated from a case of blastomycosis in America.

Aleurospores lateral, spherical, 3.5-8μ on short sterigmata.

Growth good on ordinary media, no pigmentation on ordinary media, gelatin not liquefied in the first two weeks.

TRICHOSPORIUM

Trichosporium Fries, Summa Veg. Scand. 492, 1849.

This genus was first described by Fries in his *Systema Orbis Vegetabilis* 306, 1825, without adding species, hence was not valid at that date. He failed to recognize it in the *Systema Mycologicum* in 1829, but did in the *Summa.* Since the description is most complete in the *Systema Orbis Vegetabilis,* it may be considered here. It was defined as *Flocci varii, septati, sporidiis e floccis enatis nudis adspersi* (*Saxicola, truncicola, colore varia*). Since it was reported as found on rocks, it is probable that some lichens were also included here. In no place does Fries carefully distinguish it from existing genera. In 1849 he characterized it as *Sporae simplices, nec septatae, solitariae, reliqua prioris Trichothecium.* He recognizes twelve species, all previously described, but it is almost impossible to select a type species, as none is described here. Saccardo, *Michelia* 2: 125, 1880, redefined the group, taking his *T. nigricans* as the type. In this sense, it has been used as the black-spored analogue of *Sporotrichum,* or, as defined by Lindau 1906, as the black-spored analogue of *Aleurisma.* In this sense, it is equivalent to the use of *Glenospora* of Vuillemin and later medical authors, not of Berkeley & Curtis which is an imperfect stage of *Septobasidium* (Couch 1933), a wholly unrelated fungus.

Hyphae repent, irregularly branched, brown or pale; conidia (or aleurospores) terminal or lateral on the hyphae or ultimate branches spherical or ovoid, smooth or slightly rough, brown or occasionally almost hyaline.

The whole group needs monographing before one can be certain of the proper name to apply to these species.

Key to Species

Gelatin liquefied; from generalized infection. *T. Gammeli.*
Gelatin not liquefied; from local infections.
  Aleurospores 3 × 5μ; from lesions of cornea. *T. graphii.*
  Aleurospores 5-6.5 × 6.5-9μ; from mycetoma with black grains. *T. khartoumensis.*
  Aleurospores, 6-7μ in diameter; from gummatous nodular lesions in thorax. *T. Mantegazzae.*

Trichosporium Mantegazzae Pollacci, Riv. Biol. 4: 318-328, *Pls. 1, 2,* 1922; Bolognesi & Chiurco, Micosi Chirurg. 888-895, 1927.

Isolated from gummatous nodules in swellings of the thorax. For case history see Mariani, 1923. Pathogenic for laboratory animals.

Sterile hyphae repent, branched, subhyaline then fuscous, and finally black, 7-8μ in diameter. Vegetative hyphae moniliform, black. Chlamydospores numerous. Conidiophores ascending or repent, septate, simple or branched, roughened, brown, long, slender, bearing numerous lateral conidia which are spherical or ellipsoid, easily separable, more or less in whorls, fuliginous, black, somewhat papillate, 6-7μ in diameter. Optimum temperature 15°-20° C.

Colonies small, discrete, grayish, becoming greenish gray and finally black, confluent, covering the whole surface of the medium. Surface of colony velvety, wrinkled, rugose, mammillate, not dry or shining, adherent. Ring formation in glucose broth, submersed mycelium not blackening, spores 6.5 ×

11μ. Growth good on blood agar or potato. Small colonies on serum, partially liquefying the substrate. Milk coagulated and partially digested. Gelatin not liquefied.

Trichosporium Gammeli (Pollacci & Nannizzi) Dodge, n. comb.

Glenospora Gammeli Pollacci & Nannizzi in Blankenhorn & Gammel, Jour. Clin. Invest. 4: 471-484, *9 figs.,* 1927. [Case history by Blankenhorn and Gammel, Trans. Assoc. Amer. Physicians **41**: 268-282, *9 figs.,* 1926.]

Isolated from a case of generalized mycosis involving lungs, digestive tract (?), and the epidermis, the latter with small furuncles and much necrosis, the others without either inflammation or necrosis but showing larger and deeper nodules, which soften and ulcerate as in blastomycosis. Symptoms disappeared in 61 days on medication with KI and neoarsphenamine. No recurrence in 2 years. Organism not pathogenic to monkeys, guinea pigs, or rabbits.

Sterile hyphae hyaline or subhyaline, often guttulate, continuous when young, becoming septate in age, 2-5.3μ in diameter. Cells 15-100μ long, monopodially branched, never dichotomous, larger ones frequently septate, composed of clavate cells as in *Microsporum Audouini,* sometimes fasciculate, here and there anastomosing. Fertile hyphae concolorous, decumbent, a little more slender, with short branches and with aleurospores. Aleurospores sessile on aleurophores of variable length, spherical, smooth, 3.3-6μ in diameter, at first hyaline and chlorine colored, later 10-12μ in diameter, thick-walled, granulose, pale luteofuscus. Chlamydospores spherical to irregular, 10-12μ in diameter, brown. Nodular organs resembling perithecia formed, but development stops here. Growth strictly aerobic, optimum temperature being 18°-22° C.

Growth on Sabouraud glucose agar a dense, thick, and rather undifferentiated felt of delicate hyphae, sometimes with slight concentric zones, white to light brown and yellowish brown, 2.6-3.2 cm. across in 3 weeks. On Sabouraud maltose agar, colony is white and growth slower. Best growth on Grütz malt agar, with colony brown in color. Grayish white on peptone agar and white on most other media. Upper portions of carbohydrate media darken slightly. In liquid media, powder-puff-like growths appear at the bottom and rise to the top, forming a thick pellicle. In milk, only surface growth, with alkaline reaction produced. In 8 weeks, milk finally clears with calcium oxalate and calcium acid phosphate crystals deposited. Solution is deep yellow brown in color, with light brown growth in upper third and coarse, heavy, flocculent precipitate on the bottom appearing in old cultures. Litmus broth with galactose, glucose, or fructose very slowly decolorized. No fermentation. Gelatin is liquefied in 3-4 weeks, with dense yellow mycelium on surface and fine sediment.

Var. **lanuginosus** (Castellani) Dodge, n. comb.

Blastomycoides lanuginosus Castellani, Brit. Jour. Derm. Syphilis **42**: 365-374, 1930.

Glenospora lanuginosa Agostini, Jour. Trop. Med. Hyg. **34**: 287, 288, 1931.

In tissues, cells 10-20μ in diameter, thick-walled. On Pollacci agar, hyphae hyaline, simple, septate, variously granular, 2-7μ in diameter, forming some racquet mycelium in old cultures. Aleurospores terminal or unbranched, hyphae oblong or rounded, 7-11 × 3-6μ, apiculate with thick membrane, usually single, rarely in chains of two or three. On Sabouraud's and Raulin's media, arthrospores up to 18μ in length are formed. Colonies develop 24-30 hours after inoculation. Optimum temperature for growth 25°-30° C.

Colonies on Pollacci agar spreading, languinous, rising above the surface 2-3 mm., white, then yellowish or brownish. No pigment in mannitol agar. In blood agar, colonies punctiform, confluent, slightly lanuginous, light yellow. No fermentation or acid production in carbohydrates. Gelatin and coagulated serum rapidly liquefied.

Ota & Kawatsure (1933) reduce *Glenospora Gammeli* to synonymy with their *Aleurisma tulanense* (see p. 841. *Monosporium tulanense*), but their description of cultures fits Castellani's description of *Blastomycoides lanuginosus* better than that of his *Blastomycoides tulanensis*, so that one wonders if there has not been a confusion of culture labels.

Trichosporium graphii (Harz & Bezold) Dodge, n. comb.

Aspergillus glaucus Hassenstein, Zeitschr. Parasitenk. **1**: 111-113, 1869, non aliorum.

Verticillium graphii Harz & Bezold apud Siebenmann, Die Schimmelmykosen des Menschlichen Ohres, 95, 1889.

Glenospora graphii Vuillemin, C. R. Acad. Sci. **154**: 141-143, 1912.

Description of Vuillemin was based on a corneal organism isolated by Morax.

Conidiophores verticillate, branched or solitary, ending in a single conidium; at 18°-20° C., conidium ovoid, grayish or yellowish, 7.5 × 5.7μ, or subpyriform and only 1.4μ in diameter at the disjunctor. Coremia present on poor media, not on rich. On coremia, successive conidial production takes place, but conidia never appear in chains. Conidia may be cylindric, 6.5 × 3μ, spherical, 5μ in diameter, or ovoid, 5 × 3μ. At the optimum temperature, 37° C., spores are slightly smaller.

On most media, colonies begin as small grayish tufts, then blacken, with brown mycelium penetrating the medium. No action on milk or gelatin.

Trichosporium khartoumensis (Chalmers & Archibald) Dodge, n. comb.

Glenospora khartoumensis Chalmers & Archibald, Ann. Trop. Med. Parasitol. **10**: 169-222, *Pls. 4-7*, 1916.

Isolated from a black grained maduromycosis in the Soudan.

On microscopic examination, the grains show a light-colored interior with branched, septate hyphae and chlamydospores. Hyphal cells 2.1-2.3 × 5.6-8μ; chlamydospores 7 × 15.3 × 14μ. In cultures, aleurospores appear on branched hyphae. No sexual reproduction observed. Optimum temperature 30° C.

On maltose agar, colony shows a central elevation surrounded by a groove separating it from a plateau which is grayish at first becoming darker (dusky drab, Ridgway). On glucose peptone medium, hyphae are white with a dark, reddish-brown pigment diffusing into the medium. Milk neither acidified nor coagulated. Gelatin and serum not liquefied.

There seems little to differentiate the following species from this but, since it is so much more fully described, I hesitate to reduce it to synonymy without further evidence.

Trichosporium Clapieri (Catanei) Dodge, n. comb.

Glenospora Clapieri Catanei in Montpellier & Catanei, Arch. Inst. Pasteur Algérie **5**: 489-508, 1927; Montpellier, Catanei & Clapier, Bull. Soc. Path. Exot. **20**: 502-511, 1927.

Isolated from a black grain tumor of the maxillary region. The grain in section suggested *Madurella* in appearance.

Mycelium septate, 2.5-3μ in diameter, brownish with occasional coremium formation, aleurospores terminal or lateral and sessile, on branches, smooth, ovoid, truncate, 6.5-9 × 5-6.5μ. Chlamydospores 10.5-15 × 9-15μ, intercalary or terminal, brownish black. Growth best at 37° C.

On Sabouraud glucose agar, colony black, slightly shining, with little pointed black coremia, 1-2 mm. tall, finally covered with a gray velvet, sometimes rough, with a black border, center elevated, colony deep in the gel and adherent. On ordinary agar, colony is deep brown, almost black, covered with coremia, 0.5 mm. tall, whole colony becoming 2-2.5 mm. thick with the medium brownish around the colony. On potato, colony deep gray with a velvet finer than that on Sabouraud glucose agar. On ageing it is slightly pulverulent, brown, with the color of the substrate not modified. On potato glycerol, surface is black, shining, irregular. On carrot, growth is about the same as on potato. On coagulated serum, colony small, elevated. On gelatin, both superficial and deep colonies. In peptone water, there appear small tufts, gray in color at first, then deepening, small ring, no turbidity. Milk is not coagulated, but turns alkaline after one week and continues to turn. Neither coagulated serum nor gelatin liquefied.

Doubtful Position

Glenospora gandavensis Vuillemin, C. R. Acad. Sci. **173**: 378, 1921.

Isolated from sputum, Ghent, Belgium.

Chlamydospores 6-10 × 5-8μ; hyphal cells 8-13 × 1.6-3.5μ, branching in all directions. Hyphae hyaline, without chlamydospores in Veillon agar, in low oxygen tension. Growth good at 20°-37°, optimum 32°-35° C.

On Veillon stab, surface growth only. On maltose agar, a central black dome with clear fringes. Growth on carrot blackens on the fourth day, shows chlamydospores on the fifth.

Glenospora Semoni Chalmers & Archibald, New Orleans Med. & Surg. Jour. **70**: 455-475, 1917 (nomen nudum); Semon, Brit. Jour. Derm. Syphilis **27**: 299-303, *Pl. 8,* 1915 (case history).

This name is used for the organism in cases of maduromycosis with *red grains* first clinically described by Carter in India and first cultivated by Semon from the foot of an Indian soldier in the British army in France.

Mycelium dichotomously branched with a "stippled appearance." No chlamydospores found.

On solid media, a central black zone with gray periphery which becomes black in 10 days. In Raulin's liquid, at the optimum temperature, 35° C., a delicate, translucent, grayish, feathery growth appears.

Perhaps the following unnamed species may belong here, or it may be related to *Chalara.*

Oospora sp. Sartory, C. R. Soc. Biol. **84**: 939-941, 1921.

Mycoderma sp. Sartory & A. Bailly, Mycoses pulmonaires 324, 1923.

Isolated from sputum; patient improved on medication with KI. Not pathogenic for laboratory animals.

Mycelium white, becoming brown or chocolate color, 4μ in diameter, septate, sinuous branched, walls slightly verrucose, conidiophores rigid, spores in sinuous chains, yellow and brownish, ellipsoid 5.5-8.8μ with granular contents.

On agar, colonies convoluted, irregular, powdery, white, browning after a week. On potato, brown, then mauve violet and reddish brown. On gelatin, irregular white colonies, brown, powdery, mammillate, with white pellicle. No growth on serum. Milk coagulated in 10 days, casein precipitated and digested. No indol. No action on starch. Sucrose hydrolyzed in fermentation of sugars. Gelatin liquefied.

ACREMONIUM

Acremonium Link, Mag. Ges. Naturf. Freunde Berlin **3**: 15, 1809.

The type species is *Acremonium verticillatum* Link.

Hyphae branched, septate, repent; conidiophores simple, scarcely more than short lateral branches, more or less erect bearing single solitary terminal conidia which are hyaline or light colored, mostly ovoid and small (Fig. 119).

This group has been isolated from deep-seated abscesses and from generalized infection resembling sporotrichosis, so far reported only from the Ivory Coast and once from France.

Acremonium Muthuoni Fontoynont & Boucher, Ann. Derm. Syphiligr. VI, **4**: 339-344, *Figs. 9, 10,* 1923.

Found in abscess on the neck and arm which caused intense pruritus Scratching caused flow of blood but no pus. After various antiseptics had failed, the abscesses were excised. Mildly pathogenic to rat and guinea pig.

Hyphae 1μ in diameter. Conidiophores short, straight, or curved, 5-20μ in diameter, swollen in the middle. Conidia 2.5-3μ in diameter, elongate ellipsoid.

On glucose agar, colonies grayish white, dry, powdery, reverse, slightly rose colored; agar turning brown. After 75 days, the reverse becomes brick red. On "poor" agar, growth much the same but slower and the brown deeper. Growth on maltose agar, creamy, gray, folded, suggesting the excreta of earthworms, tinted brick color. On sweet potato, colony is a white velvet finally becoming powdery; medium turns greenish. On potato glycerol, colony is of much the same aspect as the substrate and is, therefore, difficult to see. On glucose gelatin, growth is at first much as on glucose agar, then villous and shining with liquefaction on the eleventh day. In glucose broth, medium turbid, with floating white colonies which form a ring and tend to form a pellicle.

Acremonium niveum Boucher, Bull. Soc. Path. Exot. **11**: 324-327, 1918.

Isolated from lesions on hands and feet. Two cases reported cured by medication with potassium iodide. Fatal to guinea pigs.

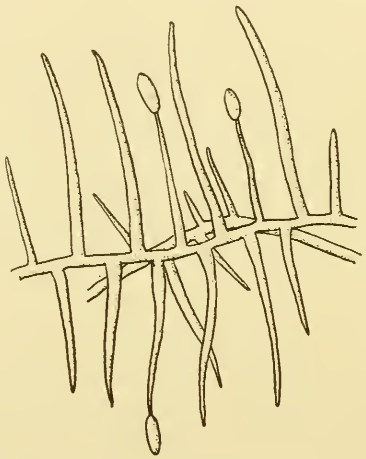

Fig. 119.—*Acremonium alternatum* Link. (After Saccardo.)

Mycelium septate, 2μ in diameter, hymenium formed of conidiophores, branching at right angles with swelling in the median portion, each branch being terminated by a long, pointed extremity bearing a single fusiform spore, 4-5 × 2-2.5μ. Conidiophores 20-22μ long, sometimes united in a coremium.

On ordinary glucose agar, growth slow, white then rose color, slightly velvety, becoming dry and wrinkled. On Sabouraud conservation agar, colony white, velvety, dry. On potato glycerol, colony snow white, depressed. On sweet potato, colony velvety, white becoming rose color, with a snow white pellicle covering the water in the bottom of the tube and extending about 5 mm. up the side of the tube. In giant colony, center wrinkled, velvety, white, radiately striate, margins rose and velvety. In glucose broth, white flakes float in all depths, forming a discontinuous pellicle, finally settling out, with hyphae growing up the glass for 6 mm.

Acremonium Potronii Vuillemin, Bull. Soc. Sci. Nat. Nancy III, **1**: 144-148 (15-19), *Pl. 2,* 1910. [First case reported by Potron & Noisette, Rev. Méd. de l'Est **43**: 132-139, 1911.]

Isolated from a generalized infection resembling sporotrichosis followed by hydrarthrosis. This was the only organism found. Medication with potassium iodide successful. Not pathogenic to guinea pigs or rabbits.

Hyphae branched, septate, scarcely 1μ in diameter, sometimes in fascicles. Conidiophores simple, usually divaricate, rarely once branched, phialiform but not septate at the base, ultimate branches, 15-20μ long, inflated below (up to 1.75μ), with a subequal neck (0.5μ). Conidia successively formed and expelled, rose, ovoid, smooth, with a short appendiculate base 4-5 × 2.2μ (Fig. 120). Optimum temperature 37°, scarcely any growth at 10° C.

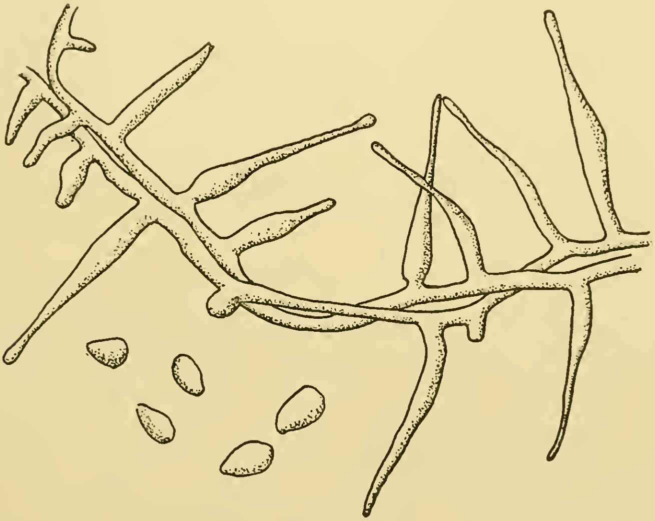

Fig. 120.—*Acremonium Potronii* Vuillemin. (After Vuillemin 1910.)

On agar, colony grayish white, smooth, covering the surface of the medium. On glucose gelatin, small white tufts, 2-4 mm. in diameter, later becoming confluent and rose color, adherent to the medium. On potato, colony finely granular, later becoming rose color. On carrot, finely radiate colonies in tufts, 3-4 mm. in diameter, white. As the tufts grow and become confluent, the colony becomes coralloid and rose color. On coagulated egg albumen, a white pellicle, becoming transparent and yellowish as the medium liquefies. On peptone broth, tufts of long, tangled hyphae on the surface and in the liquid which otherwise remains clear. In acid broth, growth poor; better in alkaline broth. In broth or peptone solution, to which nitrate has been added, pellicle white with white flocci in liquid. No indol formation. Milk coagulated and liquefied, yellowing, colonies white.

ACREMONIELLA

Acremoniella Saccardo, Michelia **1**: 270, 1878.

The type species is *Acremonium atrum* Corda.

Hyphae repent, simple or branched, hyaline or colored; conidiophores simple, short, bearing solitary terminal conidia which are spherical or ovoid, brown, unicellular.

This genus is predominantly saprophytic, but it has been isolated twice from lesions, once from a small tumor and once from the lungs. It occasionally is found as a contaminant.

Acremoniella Berti Pollacci, Atti Ist. Bot. R. Univ. Pavia **18**: 126, 127, *Pl. 30,* 1921. (Case history and cultural characters by Berti, Policlinico Sez Chirurg. **29**: 484-489, *Figs. 6-9,* 1922.)

Isolated from a small tumor. Granuloma produced in a guinea pig.

Not obtained pure; sterile hyphae repent, branched, septate, hyaline, sparse, 3-4μ in diameter; conidiophores hyaline, erect or curved, not cuspidate, 15-25μ long; conidia spherical, unicellular, 6-7μ in diameter, brown. Growing with *Penicillium Burci* Pollacci.

Grows on Sabouraud glucose; figures very poor.

Acremoniella Perinii Pollacci, Rev. Biol. **5**: 358-367, *3 figs.,* 1923.

Found in sputum from a patient with pulmonary lesion. Pathogenic to guinea pig.

Tufts at first white then fuscous, diffuse; sterile hyphae repent, intricate, septate, hyaline or pale; conidiophores erect, simple, short, 3.5-4μ in diameter, 16-24μ long, septate or continuous, pale, apex obtuse or often inflated. Conidia spherical, granulose, hyaline at first, becoming avellaneous, echinulate, unicellular, acrogenous, 7.8-9.7μ in diameter.

Colony grayish at first, then brown. Growth on potato, silky white, with small islands of green, then the surface becomes brown. No growth at 20° C., good at 37° C. At 45° C., a pellucid colony, white, rapidly turning brown. No growth at 55° C. On milk, after 4-5 days, coagulation followed by peptonization, mycelium brownish with violaceous tint.

Acremoniella (Acremoniopsis) olivaespora Ciferri & Ashford, Mycologia **22**: 62-68, *2 figs.,* 1930.

A saprophyte isolated from human skin.

SPOROTRICHUM

Sporothrichum Link, Mag. Ges. Naturf. Freunde Berlin **3**: 12, 13, 1809.

The type species is *Sporothrichum badium* Link.

In the original description of the genus eleven species are described as new, and *S. virescens* and *S. abietinum* transferred here from Persoon's genus *Dematium.* Most of the species were bright colored and were found on decaying wood. Since *S. badium* is the only one figured and the first to be described, it may be taken as the type of the genus.

Link describes the genus as follows:

3. *Sporothrichum. Thallus e floccis intricatis decumbentibus aut erectiusculis, ramosis, septatis, Sporidia ubique inspersa, rotundata.*

Caespitibus late effusis truncos caesas aliaque vegetabilia putrescentia investiunt. Varios habent colores, saepe pulcherrimos. Sporidia plerumque globosa, parva aut minuta, varia copia inspersa. Pleraeque species persistunt. Genus hinc affine Asporotricho et Dematio quibus vero sporidia nulla, inde Botryti, a quanam floccis decumbentibus differt a Geotricho, Trichothecio, Epochnio discrepat sporidiis multo minoribus nec truncatis, nec didymis nec appendiculatis. Pleraeque species nondum descriptae.

Sp. badium caespitibus tenuibus, floccis badiis decumbentibus, sporidiis parvis. Tomenti instar tenuis truncos emortuous humidos late obducit, saepe Sphaeriis incumbens. Sporidia non ita crebra. Iconem V. fig. 14.

A study of Link's Fig. 14 shows a repent, septate mycelium with scattered lateral, nearly spherical conidia, no erect conidiophores.

In 1815, Link again treated the genus, adding his previous *Asporothricum* and *Dematium*. He divided his genus into two subgenera, *Lysisporium*, thallus septate, densely covered with spores, easily falling apart, and *Alytosporium*, thallus either septate or not, conidia strongly adherent, rarely absent. His type species, *S. badium*, belongs in the latter. The first subgenus contained thirteen species, the second twelve. The descriptions are extremely brief, based largely on the host. As a whole, the genus seemed to be saprophytic on deadwood, although fallen leaves and earth are mentioned.

In 1818, Link again treated the genus, adding species which he had previously treated in *Aleurisma* and *Collarium* and separating *Alytosporium*. He no longer recognized subgenera and arranged his key strictly on the basis of color. Thus, his genus *Sporotrichum* of 1818 becomes the same as his genus *Aleurisma* of 1809, while his *Sporothrichum* becomes *Alytosporium* in 1818.

Martius, *Flora Cryptogamica Erlangensis* 335-337, 1817, treated the genus, including only species already described by Nees and Link.

Nees, *Das System der Pilze und Schwämme* 1816, described *S. laxum* and mentions several of Link's species. He would select the group of *S. fulvum*, *S. badium*, etc., as true *Sporotrichum*.

In Gray's *Natural Arrangement of British Plants* 550-551, 1821, 5 species are described, all originally described in Link, 1809, including *S. badium; Aleurisma* not mentioned.

In his Systema Mycologicum 3: 415-425, 1832, Fries treats 32 species, arranging them by color, as Link had done in 1818. Saccardo, Michelia 2: 16, 1882, considers *S. roseum* or *S. virescens* as the type of the genus.

In 1885, Saccardo & Marchal (Bull. Soc. Roy. Bot. Belgique 24: 65) described *Rhinocladium* based on *R. coprogenum* from rabbit dung (Fig. 121) later adding *Sporotrichum torulosum* Bonorden. This genus was evidently erected to be analogous to *Sporotrichum*, but differed in having black spores. It is said to differ from *Trichosporium* Fries by the presence of sterigmata. As the presence or absence of color is rather variable in this group, it has seemed best to retain *Sporotrichum*, although the commonest species, *S. Schencki*, might with equal propriety be placed in *Rhinocladium*, as is frequently done by French workers.

Hyphae septate, repent, irregularly branched. Conidiophores not differentiated, or at most, a terminal conidium on a short branch; conidia lateral or terminal, often sessile or on a short sterigma, ovoid or spherical, hyaline or light colored, usually small.

This is a large, rather poorly defined genus of saprophytes, which has been used as a place to put poorly defined mycelia with spores ever since it was first created. Some of the older mycologists, such as Saccardo and Lindau, placed most of the dermatophytes here without regard to their evident relationships. There are few pathogenic species, but one of them, *S. Schencki* and its variety *Beurmanni,* is rather widespread and serious.

The organism often enters through a wound, such as a prick of a thorn, and produces cutaneous lesions which may or may not later become systemic. The cutaneous types, in which multiple subcutaneous gummata develop with or without ulceration, appear to be the most frequent type in France, while lymphangitic sporotrichosis and adenitis seem to be more frequent in the American literature. Where the disease becomes systemic, various organs may be involved, such as the mucous membranes, muscles, bones, joints, very rarely the testicles, epididymis, lungs, and brain. For a full recent discussion of the clinical aspects of this disease, the reader is referred to the excellent account in Beurmann & Gougerot, *Les Sporotrichoses*, 1912, and Jacobson, *Fungous Diseases* 128-145, 1932.

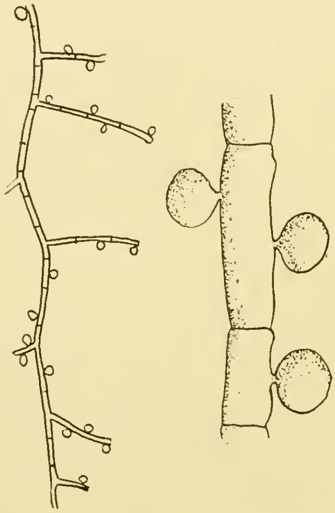

Fig. 121.—*Rhinocladium coprogenum* Saccardo & Marchal. (After Marchal.)

The delimitation of species in this genus is very difficult. Color, which has often been used not only to separate species but even genera, has been shown by Davis (1915) to be variable. Practically all the strains that he tried formed pigment when first isolated; carrot, potato, 3% maltose agar, and 3% glucose agar are more suitable media for pigment production, as is also an abundance of oxygen, while light is apparently without effect. Albino strains frequently occur and remain fixed even after passage through an experimental animal. Meyer & Aird (1915), after a study of 18 strains, found some differences in carbohydrate fermentation, but these were not sufficiently constant or correlated with other characters to warrant separation into species. Meyer (1915), while admitting that rarely is the equine sporotrichosis transmitted to man, was unable to find sufficient differences in the strains to separate them.

Benham and Kesten (1932), working with *Sporotrichum Schencki* produced nodular sporotrichosis in a monkey similar to the lymphangitic type in man. They found the human disease transmissible to carnations, in which it produced lesions similar to those produced by *S. Poae,* a common pathogen of these flowers. After living parasitically and saprophytically on plants, *S. Schencki* retained its virulence for animals while *S. Poae* and *S. pruinosum,* from the soil, showed no pathogenicity for experimental animals at any time.

Lesions produced by *Sporotrichum* respond readily to medication with potassium iodide, although this salt is not toxic to the fungus in cultures. Davis (1919) suggests that it may stimulate the host cells to proliferate and heal the lesions.

Key to Species

- Colonies remaining white or pink on all media.
  - Gelatin not liquefied.
    - Colony becoming pink on potato. *S. Grigsbyi.*
    - Colony becoming yellowish on potato. *S. Fonsecai.*
  - Gelatin liquefied.
    - Milk not coagulated, producing a pellicle on liquid media, clavate bodies in lesions as in *Actinomyces bovis;* from subcutaneous lesions. *S. asteroides.*
    - Milk coagulated, producing islets which quickly settle, without forming pellicle on liquid media, no clavate bodies in lesions.
      - Ulcers in mouth in man. *S. cracoviense.*
      - Lesions on horse similar to those produced by *Zymonema farciminosus;* Madagascar. *S. equi.*
    - Action on milk unknown, little or no growth on liquid media, no clavate bodies in lesions; ulcers. *S. Carougeaui.*
- Colonies often becoming black or brown on most media.
  - Gelatin not liquefied. *S. Jeanselmei.*
  - Gelatin slowly liquefied. *S. Schencki.*

Sporotrichum Grigsbyi Dodge, n. sp.

Sporotrichum Schenckii Grigsby and Moore, Southern Med. Jour. **15**: 684-687, 1922, non aliorum.

Isolated from lesions on chest, elbow, and neck.

Morphology as described from smears unintelligible.

Aerobe, sporogenous, nonliquefying. Pinkish colony after 6 days on potato or plain agar. Colony otherwise white, dry, heaped up, and wrinkled. No indol. No fermentation of glucose, sucrose, or lactose broth, no turbidity, sediment granular, pellicle(?) formed. Litmus milk unchanged.

Sporotrichum Fonsecai Pereira Filho, Rev. Med. Chirurg. Brasil **37**: 265, 266, *1 pl.*, 1929; *Ibid.* **38**: [3-21], *Pls. 1-24*, 1930.

Rhinocladium Fonsecai Grandinetti, Centr. Estudo Esporotricose São Paulo 52, 1934.

Isolated from abscesses on the nose, Brazil. Pathogenic to rats and mice.

Mycelium branched, often in large strands of parallel hyphae, conidia mostly terminal on these strands, 9-20 × 1-2μ, 2-7 × 1-2μ; chlamydospores abundant in old cultures.

On plain agar, colony white, center granular, margin striate. On grape juice agar, growth more rapid and medium somewhat darkened. On Sabouraud agar, colony white, creamy, cerebriform, very adherent, yellowish, finally becoming slightly brownish. Colony similar, but remaining white on conservation agar. On human blood agar, growth rapid, slightly brownish. Similar on glycerol agar. On potato and potato glycerol, colony white at first, becoming yellowish. On bile potato, colonies prominent, yellowish, surface granular, with depressions finally somewhat brownish. On carrot, beet, banana, sweet potato, turnip or manihot, colonies white, eventually becoming slightly brownish, adherent. On gelatin at 17° C., colony white, prominent, without liquefaction; medium becoming brownish. Glucose gelatin finally liquefied. On plain broth, floccose sediment, upper portion of the liquid clear. On glucose broth, a pellicle is formed, which soon settles to the bottom without breaking up. No fermentation of sugars; acid with glucose, fructose, and maltose. Milk supports rapid growth and is coagulated.

Sporotrichum asteroides Splendore, Rev. Soc. Sci. São Paulo **3**: 62, 1908; Brasil Med. **33**: 361-365, *2 pls.*, 1909.

Rhinocladium Beurmanni var. *asteroides* Vuillemin, 1910.

Sporotrichum Beurmanni var. *asteroides,* Beurmann & Gougerot, Arch. de Parasitol. **15**: 40-45, 1911.

Rhinotrichum asteroides Verdun, Précis Parasitol. 1912; Verdun & Mandoul, Précis Parasitol. 714, 715, 1924.

Sporothrix asteroides Davis, Jour. Infect. Dis. **12**: 453-458, 1913.

Rhinocladium asteroides Grandinetti, Contr. Estudo Esporotricose São Paulo 53, 1934.

Found in subcutaneous lesions, in general much as in the European *S. Beurmanni* and North American *S. Schencki* (case history and pathology in full in Brasil Med. **33**: 361-365, *2 pls.*, 1909). In experimental lesions, organism regularly produces ray-shaped bodies suggesting those seen in *Actinomyces bovis,* hence the name.

At first budding forms, then septate hyphae, spores at first isolated and hyaline, lateral as well as terminal, later crowded, often verticillate and dark colored. Optimum temperature about 30° C., organism growing more slowly at lower temperatures.

Grows on all the common media, but prefers media with glucose and slightly acid. Growth good on slightly acidified rye grains, slower on potato, without pigmentation on the latter. Slowly liquefies gelatin, does not coagulate milk. Growth superficial on liquid media, leaving the liquid clear.

Sporotrichum cracoviense Lipiński, Medycyna Doświadczalna i Spoteczna **2**: 153-169, *7 figs.*, 1924.

Oospora sp. Grütz, Sporotrichosen und verwandte Krankheiten, Handb. Haut- Geschlechtskr. [Jadassohn] **11**: 797-799, 1928.

Found in lesions on the tongue of an otherwise healthy ten-year-old girl. First ulcer on tongue, then on hard and soft palates, and on tonsils. Some lesions were small, hard, pinhead size, grayish white, reddish below, removed by platinum loop with difficulty but without causing pain. Other lesions, on tonsils and hard palate, apparently derived by softening of nodules, were flat, shallow, ovoid, with irregular edges. Glands not swollen, temperature normal. The patient had returned from the Soviet Republic only a short while before. Patient seen only once, since mother refused to permit hospitalization or further treatment. Pathogenic to white rats.

In the nodules, cells spherical or ovoid, 2-3 × 6-7μ. Hyphae short, branched, terminal cells swollen. Gram-positive, old hyphae not staining, acid-fast. Some are partly gram-positive and partly negative. In cultures, sterile and fertile cells grow along side of hyphae, sessile or in fine sterigmata, either singly or in groups. Chlamydospores present.

This organism grows well on a variety of liquid or solid media either with or without sugar, aerobically or anaerobically, between 18° and 37° C. On Sabouraud agar, colony circular or slightly oval, silvery white, dull, slowly becoming convex, elevated above the surface of the agar with a delicate, velvety margin, growing at an irregular rate so that it finally becomes cerebriform. Reverse concolorous even after 10 weeks. Growth on potato rather poorer than is the case with other species, but growth good in water of condensation. On Loeffler's medium, growth good and characteristic, center colonies being surrounded by an aureole with rays like icicles. On gelatin, either with or without sugar, growth good, colony becoming crateriform with a wide rim, finally, as the medium liquefies, reaching the bottom. No characteristic growth on blood agar, no hemolysis. In common broth, tiny surface colonies appear after 24 hours. These settle to the bottom on shaking. Odor nauseating on standing. Growth still good in broth covered with paraffin. Milk is coagulated in 6 days, with sediment and turbidity of the medium.

Pleomorphism.—At room temperature (more slowly at 35°-37° C.), the center of colony becomes covered with rugose coremia, destroying the appearance of the colony. At thirty-fourth day, colony rounded, with or without development below the surface of the medium, colorless at first, later becoming pearly, retaining aureole, adherent. Appearance changes on subcultures. Yeast forms are produced on many different media when temperature is changed. Colonies consisting of yeast cells small, flat, oval, brownish white, slimy.

Sporotrichum equi, Carougeau, Jour. Méd. Vét. Zoötechnie **60**: 8-22; 75-90; 148-153, 1909.

Epizöotic on horses in Madagascar, symptoms similar to those caused by *Zymonema farciminosum,* with which it since has sometimes been confused.

Thought by Hyde & Davis, Jour. Cutan. Dis. **28**: 321-352, *Pls. 36-45,* 1910, to be identical with *S. Schencki* as in America, organisms in horse and man are identical. It is distinct from *Zymonema farciminosum.*

Mycelium 1.5-2μ in diameter, spores on a very short pedicel, often in groups of 6-10, spores ovoid to pyriform, sometimes nearly spherical in old cultures. Hypnospores formed in old cultures.

On ordinary agar or glycerol agar, colonies star-shaped or irregularly dentate, circular, slightly elevated, whitish, shining, very adherent, penetrating the medium 1-3 mm. On Sabouraud agar, colonies round, yellowish white, elevated, adherent, surface folded. On potato, colonies granular, verrucose, grayish white, dry, not abundant. With glycerol added, the growth is much more luxuriant. On coagulated ox serum, development slow, colonies small and with black points. In peptone meat broth or, better, in that to which glucose or glycerol has been added, colonies white, floccose, attached to sides and bottom of the tube, liquid remaining clear even on shaking. In glucose or glycerol broth also, floating colonies as small islands. Milk coagulated in 2 weeks. Gelatin liquefied slowly after several weeks.

Sporotrichum Carougeaui Langeron apud Brumpt, Précis Parasitol. ed 2, 1913 (fide Langeron Bull. Soc. Path. Exot. **15**: 453-459, 1922, footnote); Fontoynont & Carougeau, Bull. Soc. Path. Exot. **15**: 444-453, 1922.

Rhinocladium Carougeaui Neveu-Lemaire, Précis Parasitol. Hum. 85, 1921.

Found in cutaneous ulcerous lesions in the hands of a six-year-old child, also suffering from tuberculosis. Medication with KI helped, but did not cure at once. Ten years later the child was well. Fontoynont & Carougeau give case history in detail.

Mycelium septate, rampant, 2.5-5μ in diameter (mean 3μ), more voluminous than in *Rhinocladium*. Cells 8-10μ long; conidia ellipsoid, 2 × 4μ, becoming spherical, 4-4.5 and even 5μ in diameter when detached. Conidia attached by definite sterigmata, arising variously all along the hyphae. Occasionally yeast forms produced both in culture and in lesions. Best growth at 19°-22° C.

Organism easily isolated on sugar media. On agar, colony creamy, white. On glycerol agar or maltose or glucose agars, growth is equally favorable, colony elevated, wrinkled, vermiculate, adherent, without the sharp peak in center characteristic of *S. Beurmanni*. Folds vary from 0.5 to 4 mm. thick. Color silvery white on glycerol or glucose agar, yellowish on maltose. On manioc with glycerol, growth less abundant than on agar, forming a white, thin, farinaceous colony without folds, becoming slightly tomentose in 2 weeks. On potato glycerol, colony 1-2 mm. thick, white or slightly grayish, surface irregular with coremia, and white flakes floating in the glycerol solution at the bottom of the tube. On carrot glycerol or turnip glycerol, colony similar but more humid, creamy, growth slow. On banana, colony folded, gray on reddish background, spreading very little, formed of small, rounded, confluent colonies, slightly brown. On gelatin stab, surface colony folded, white, with inverted pine tree below; liquefaction on tenth day. On green bamboo bark, growth good, farinaceous, white. Liquid media (glycerol or sugars), show good growth in flakes, which settle to bottom but are easily suspended on shaking. Little or no development in broth.

Sporotrichum Jeanselmei Brumpt & Langeron, Bull. Mém. Soc. Méd. Hôp. Paris III **29**: 792-796, 1910; also note in III **29**: 824, 1910. Bull. Soc. Franç. Derm. Syphiligr. 21: 190-192, 1910. (First case, Jeanselme & Chevallier, Bull. Mém. Soc. Méd. Hôp. Paris III, **29**: 784-792, 1910.)

Rhinocladium Jeanselmei Grandinetti, Contr. Estudo Esporotricose São Paulo 53, 1934.

Found in widespread lesions, closely resembling syphilitic gummata, on skin, bones, etc. Medication with large doses of KI promptly cleared up the lesions. Probably the case of Bedell (1914), from the eye, should be referred here.

Cultures of this organism show all stages between blastospores formed directly on conidia and well-developed mycelium. Occasionally, one spore has four spores attached by sterigmata or by a short germ tube, bearing the tuft of spores on its end, as in smuts. Mycelium, as usual in *Sporotrichum*, composed of elongate fine filaments, abundantly branched, tangled, septate; spores either in small tufts or isolated along the filaments. Tufts either terminal or at the ends of short, lateral branches. Each spore, borne on a short sterigma, brownish and spherical when detached. Tufts usually only 4-5-spored. Hyphae 1.5-2μ in diameter, spores 2.5-3.5μ in diameter, sterigmata 1-1.5 × 0.5-0.85μ. *Sporotrichum bombycinum* Corda differs in having filaments thicker, spores hyaline, attached singly to branches 15-26μ long and of nearly the same diameter as the principal filament. *S. Beurmanni* has mycelium more slender and more abundant, 1.5-1.7μ in diameter. Short forms exceptional. Tufts of spores larger, containing 12-15 spores. Lateral spores closer together, ellipsoid, 3.5 × 2.6μ, or pyriform, 4 × 2.4μ.

On most media, colonies compact, resistant, adherent. Organism grows on usual media. Growth best at 35°-37° C. On Sabouraud maltose agar, growth tomentose. On glucose peptone agar (first isolation), growth in 8 days, center of colony smooth, then a ring of striate radiating crests and outside a "crown of rays." Colonies cream color to old ivory. On potato without glycerol, white velvety colonies on fourth to eighth day. Thirty-four days later, colonies size of lentils, flat, furrowed, with radiating folds and little sharp peaks. On potato glucose in incubator, growth visible on sixth day, cream white, blackening on fourteenth day. On thirty-fourth day, surface covered, coal black, in hollows, slightly ashy, powdery on ridges. On carrot, white colonies, becoming black with white border. Growth much slower than on potato. On gelatin, smooth pearly little points on the surface, radiating and filamentous on walls of the tube after 3-4 weeks. Center of colony a conic umbo; periphery, a white zone with fine striations at bottom of a deep umbilical depression. In broth, a fragile pellicle composed of small white nodules surrounded by rays, medium remains clear. Gelatin not liquefied.

Sporotrichum Schencki Matruchot, C. R. Acad. Sci. **150**: 544, 1910.

Sporotrichum sp. E. F. Smith in Schenck, Johns Hopkins Hosp. Bull. **9**: 286-290, *1 pl.*, 1898.

Sporothrix Schencki Hektoen & Perkins, Jour. Exp. Med. **5**: 77-89, *Pls. 2, 3,* 1900.

Rhinocladium Schenki Verdun & Mandoul, Précis Parasitol. 713, 714, 1924.

Rhinocladium Schencki Grandinetti, Contr. Estudo Esporotricose São Paulo 18, 1934.

Rhinotrichum Schenkii Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Hyphae about 2μ in diameter, irregularly staining with Gram's stain. Mycelium formed of parallel strands of curved hyphae, few or no lateral branches. Spores rare along the hyphae, usually terminating them, 3-5μ in diameter, ovoid or apiculate (Fig. 122), staining with Gram stain.

Optimum temperature 30°-38° C., growth slow at room temperature. Colonies show straight furrows, not cerebriform. Lactose fermented, not sucrose. Culture remains colorless indefinitely, with a brownish pigment developing in the aerial portions. Spores hyaline, aerial fructification normal. In deeper and moister portions of the cultures, spores sprout below into short, irregular chains, 5-8 spores long.—Matruchot.

The following data come from the original description. Colony on agar white, wrinkled, becoming brownish or even dark brown and velvety. Growth on potato yellow, becoming brown, medium darkening. Tufts of mycelium appear in broth, also islets on the surface. Litmus milk is unchanged, with little growth occurring. No fermentation, no liquefaction of serum. Gelatin slowly liquefied.

Chlamydospores appear in media poor in nutrients, but are not abundant, as in some strains of *Sporotrichum Beurmanni.* Davis (1914) believes that the chlamydospores do not afford a sufficient criterion for the separation of these two species.

Var. **Beurmanni** (Matruchot & Ramond) Dodge, n. comb.

Sporotrichum Beurmanni, Matruchot & Ramond, C. R. Soc. Biol. **57**: 379, 1905. (First case Beurmann & Ramond, Ann. Derm. Syphiligr. IV, **4**: 678, 1903.)

Rhinocladium Beurmanni Vuillemin, in litt. apud Beurmann & Gougerot, Arch. de Parasitol. **15**: 98, 1911.

Sporotrichopsis Beurmanni Guéguen, apud Beurmann & Gougerot, Arch. de Parasitol. **15**: 103, 104, 1911.

Rhinotrichum Beurmanni Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Isolated from the pus in small tumors in the subcutaneous tissues. Tumors possess definite walls, become about the size of a peach stone, are at first painless, later becoming painful on pressure, finally filled with odorless, granular pus.

Mycelium recumbent, 2μ in diameter, colorless, much branched, tangled. Fructifications are composed of large, cylindric masses, 10μ in diameter, sometimes elongated. Spores terminal on long hyphae or on branches, solitary, variable in number, irregularly borne, pyriform, rarely on a sterigma, 1-2μ long by 0.5μ in diameter. Spores become ovoid and brown, 3-5 × 2-4μ. Optimum temperature 22°-30° C., growth slow at 37° C.

Colonies on Blanchetière & Gougerot medium (carbohydrate 30 gm., peptone 10 gm., water 1,000 c.c.) at 22°-25° C., are confluent, white at first, rapidly

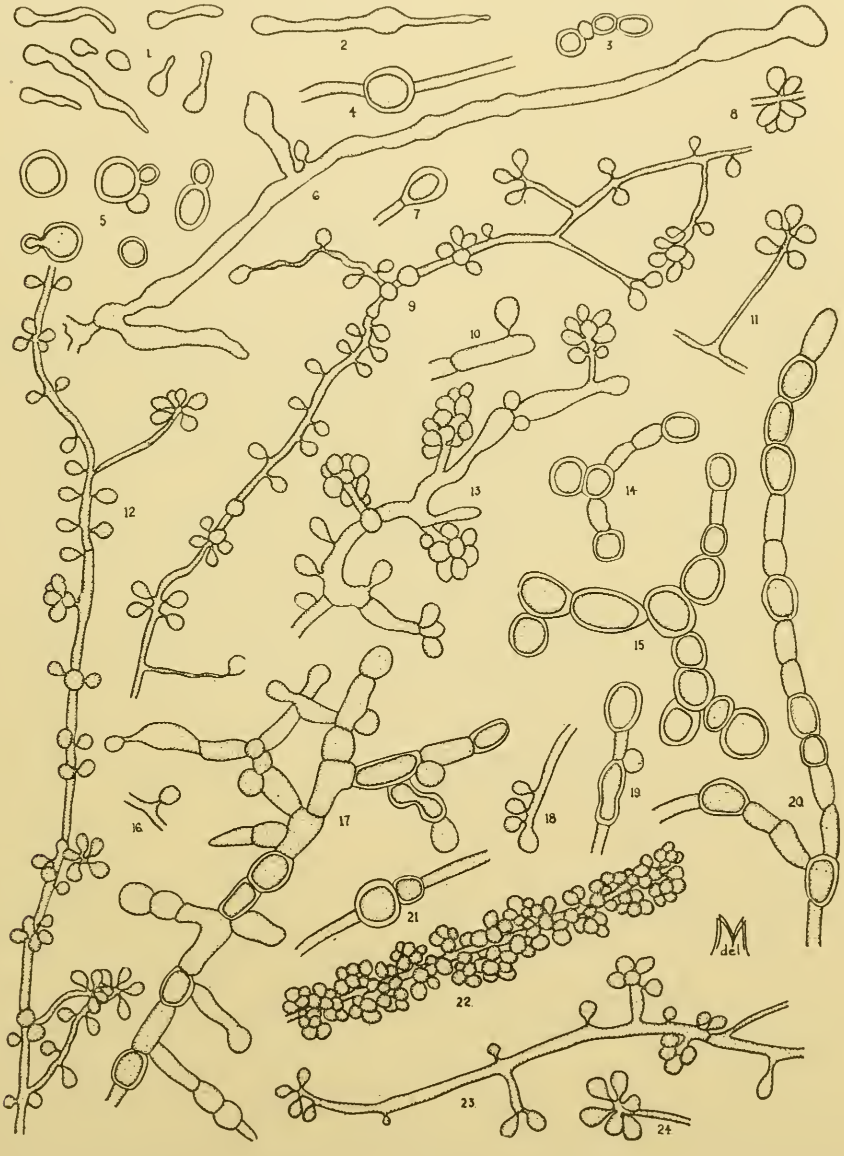

Fig. 122.—*Sporotrichum Schenki* var. *Beurmanni.* *1, 2,* germinating spores; *3, 14, 15, 20,* oidia on various media; *4,* intercalary chlamydospore; *5,* yeastlike cells; *6,* young filament; *7,* terminal chlamydospore; *8-13, 16, 18, 22-24,* conidia showing variation in arrangement on hyphae in various media; *17, 19-21,* mycelium with chlamydospores on various media. (After Moore 1934.)

and completely becoming dark brown when the fructifications form, cerebriform, convoluted. Same on carrot or potato. Acid formation with glycerol, glucose, galactose, sucrose(?), maltose, inulin, starch (slight), but not with mannite, dulcite, dextrin, lactose. When $CaCO_3$ is present acetic acid is also formed.

This variety is doubtfully distinct from the species, as has frequently been pointed out.

Var. **Greconis** Dodge, n. var.

See Mackinnon, Arch. Soc. Biol. Montevideo, Suppl. Fasc. **5**: 1320-1327, 1931.

Agrees with above, but does not acidify sucrose.

Var. **Fioccoi**, Dodge, n. var.

Sporotrichum epigaeum Aschieri, Atti Ist. Bot. R. Univ. Pavia IV **1**: 199-222, *8 figs., 2 graphs*, 1930. Not Brunaud, Nouv. Fragm. Mycol. II, 11, Bordeaux, 1888; Saccardo, Syll. Fung. **10**: 534, 1892.

Sporotrichosis case of Fiocco.

Conidiophores 2.5-4μ in diameter, varying in length with the media, septate, straight or variously contorted, with short lateral branches; spores sessile, 2.5-3μ in diameter, rounded or slightly elongate; chlamydospores intercalary or terminal, spherical, 7-10μ in diameter, or elongate, $7 \times 10\mu$. Conidia solitary or sympodially in small groups on short branches or in whorls, sometimes suggesting conditions seen in *Beauveria*.

Growth curves are given for 5° intervals between 5° and 30°, showing an optimum at 20°.

Colonies on Pollacci agar whitish, floccose, smooth becoming rugose, canary yellow in spots. Aschieri reports development of chestnut colonies, moist, surface verrucose covered with white conidial hyphae; sometimes a sector, completely covered with conidial hyphae and surrounded by a yellow ring. In Sabouraud agar, colony smaller, verrucose, covered with a white layer of mycelium with a yellow margin 3 mm. broad. On potato, colony whitish, covered by a white cottony layer. On carrot, colony similar, but with a slightly yellowish color. On liquid media, a ring developed with a gelatinous mass in the bottom of the tube.

Var. **Councilmani** (Wolbach) Dodge, n. comb.

Sporotrichum Councilmani Wolbach, Jour. Med. Res. **36**: 327-355, *4 pls.*, 1917.

Rhinotrichum Councilmani Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Rhinocladium Councilmani Grandinetti, Contr. Estudo Esporotricose São Paulo 53, 1934.

Isolated from a lesion in the knee, which followed a wound from a nail in an ash barrel, Boston. Pain developed in one week. Case unimproved after 2 months, with a variety of treatments. Knee joint fixed. In about 5 months, pain disappeared, but joint still completely fixed. Pathogenic to rabbits and guinea pigs, giving the typical lesion.

Hyphae 1-1.25μ in diameter, branching, irregular, the young sporiferous branch often somewhat swollen in the proximal region, septate. with the septa occurring at intervals of from 10-22μ. Spores hyaline, 1-celled, pyriform, 7-6 × 2.5-3.5μ, solitary or usually in clusters, formed by successive apical proliferation at the tips of aerial sporophores, rarely sessile on the walls of the vegetative hyphae, the point of attachment being marked by a slight denticulation of the fertile branch. Pleomorphic mycelium is characterized by a free aerial growth of hyphae, abundant spore formation, large size of spores, absence of lateral spore clusters, and occurrence of septate branching filaments in lesions.

Doubtful Position

Sporotrichum congolensis (Baerts) Dodge, n. comb.

Discomyces congolensis Baerts, Bull. Méd. Katanga. **2**: 67-75, 1925.

Actinomyces congolensis Brumpt, Précis Parasitol. ed. 4, 1206, 1927.

Lesions originally described by van Nitsen, Ann. Soc. Belge Méd. Trop. **1**: 1920.

Found in subcutaneous nodules of pea size, later growing to pigeon egg size, becoming adherent to the skin and softening. On puncture, these yield a clear, viscid liquid which soon becomes purulent, yielding mycelium. These ruptured nodules may either heal spontaneously or be secondarily infected. Some ulcers, with irregular borders, gradually extend, involving muscles, joints, rarely also bones. The pus shows small yellowish or grayish gelatinous grains, 1-2 mm. in diameter, some even being as large as 3-5 mm. Medication with arsenicals, salvarsan, and KI ineffective.

In the grains, hyphae cylindric, long aseptate, glassy, hyaline, varying from 0.33-5μ in diameter, most being 1-3μ, dichotomous, straight, curved or spiral, with lateral, rarely terminal, pyriform spores, 8-9 × 2-4μ.

Organism not cultivated.

This is evidently not an *Actinomyces,* probably an *Indiella* or *Sporotrichum,* but is difficult to place in the absence of figures or more adequate description.

Rhinocladium guayaquilense Valenzuela. Brumpt, Précis Parasitol. ed. 4, 1329, 1927.

Sporotrichum indicum Castellani & Chalmers, Man. Trop. Med. 622, 1910.

Rhinocladium indicum Vuillemin apud Verdun & Mandoul, Précis Parasitol. 115, 1924.

Sporotrichum Beurmanni var. *indicum* Beurmann & Gougerot, *Les Sporotrichoses* 143, 1912.

Imperfectly described and cultures lost.

Sporotrichum Lesnei (Vuillemin) Castellani & Chalmers, Man. Trop. Med. ed. 3, 1121, 1919.

Rhinocladium Lesnei Vuillemin, Bull. Soc. Sci. Nancy **11**: 139-144 (10-15), *Pl. 1*, 1910.

Originally described as producing mycetoma pedis in Madagascar. Fontoynont & Carougeau, *in litt*, published by Beurmann & Gougerot, Arch. de Parasitol. **15**: 13, 1911, state that it was an impurity found in a secondary infection of a lesion of a different nature.

Hyphae branched, septate, 1.3μ in diameter, scarcely fuliginous, discrete or fasciculate, and then ascending or erect. Conidia oblong or ovoid, short pedicellate, fuliginous, 4-7 × 3-3.5μ, solitary on hyphae, occasionally or frequently with denticulate apex, cylindric or rarely nodose. The fasciculate hyphae simulate *Graphium* (Fig. 123).

Sporotrichum lipsiense Benedek, Derm. Woch. **83**: 1770-1777, 1926.

Isolated from various superficial epidermal lesions accompanied by pruritus and intertrigo.

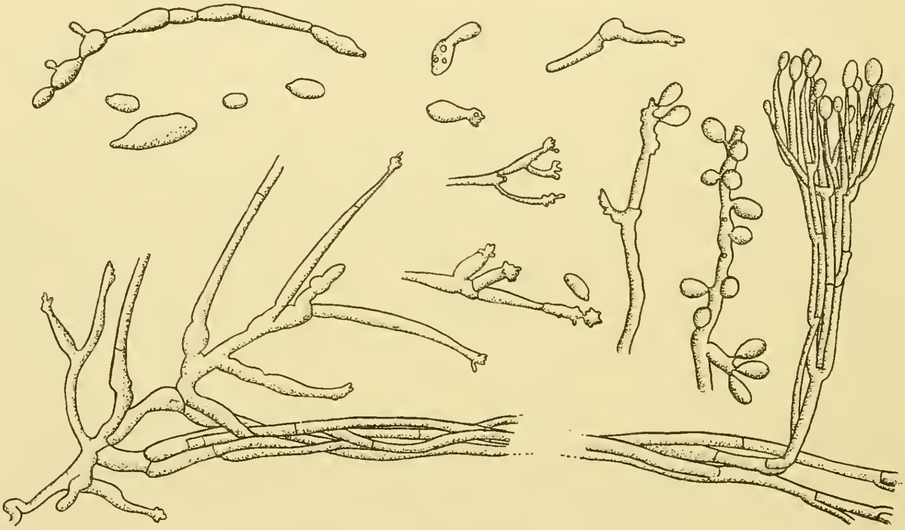

Fig. 123.—*Sporotrichum Lesnei* Vuillemin. (After Vuillemin 1910.)

Mycelium septate, 2-4μ, mostly 3μ, in diameter, cells 8-12μ long, occasionally 20-28μ. No differentiated conidiophores, spores lateral or terminal ovoid and almost pyriform, becoming spherical after abjunction, sessile or with a short slender sterigma, 3-4μ in diameter. Chlamydospores 4 × 5-8 × 12μ. Sprouting forms 6 × 6-5 × 8μ, hyaline. Cultural optimum temperature 18°-20°, growth ceasing at 25° C. On glucose agar, glycerol, potato or glycerol carrot, growth gray white, dull, moist, flat, becoming rough from tufts of hyphae and finally white velvety. Ferments glycerol and mannitol, not dulcitol, glucose, galactose, fructose, sucrose, maltose, lactose, dextrin, starch, or inulin.

Sporotrichum bronchiale Montagne. Plant. Cell. Nouv. 92 [cited by Saccardo, Syll. Fung. **4**: 100, 1886].

Isolated from bronchomycosis, case of Gubler.

Hyphae white, branched, repent or erect; septate, cells 5-7μ in diameter; conidia hyaline, spherical, 5μ in diameter.

I have been unable to locate the original place of publication, and suspect that Saccardo may have been in error, as it is not in Montagne's *Cent. Plant. Cellulaires Nouv.* No. 92, Ann. Sci. Nat. Bot. II, **20**: 370-372, 1844. Montagne did not recognize the species when he compiled his *Sylloge Gen. Spec. Pl. Cryptog.* 1856, containing all the species he had previously described in systematic order. Castellani & Chalmers do not quote an authority for their statements, and Jacobson copies Castellani & Chalmers.

Rhinocladium parvulum Redaelli, 1923; Grandinetti, Contr. Estudo Esporotricose São Paulo, 43, 1934.

Sporotrichum parvulum Brunaud.

Isolated from lungs in cases clinically resembling tuberculosis.

BIBLIOGRAPHY

Achard, Ch. & Louis Ramond. 1909. Sporotricho-tuberculose, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 27: 738-743.

Adamson, H. G. 1908. Sporotrichosis, a résumé of the literature relating to sporotrichal infections of the skin, *Brit. Jour. Derm. Syphilis* 20: 296-303.

—. 1911. A case of sporotrichosis, *Brit. Jour. Derm. Syphilis* 23: 239-246, *Pls. 1, 2, Figs. 1, 2.*

—. 1913. A case of sporotrichosis of the disseminated, ulcerating, gumma type, in which there occurred acute synovitis, *Brit. Jour. Derm. Syphilis* 25: 33-37, *4 figs.*

—. 1913. A case of sporotrichosis simulating blastomycosis, *Brit. Jour. Derm. Syphilis* 25: 60-64, *2 figs.*

—. 1922. Sporotrichosis (with cultures) [described by T. Joekes], *Proc. R. Soc. Med. Derm. Sect.* 15: 18, 19.

Agostini, Angela. 1931. On Blastomycoides lanuginosus Castellani, *Jour. Trop. Med. Hyg.* 34: 287-288, *2 figs.*

—. 1932. Sul Blastomycoides lanuginosus Castellani, *Atti. Ist. Bot. R. Univ. Pavia* IV, 3: 65-68, *2 figs.*

Aguiar Pupo, João de. 1920. Sporotrichoses no Brasil, *Annaes Paulistas Med. Cirurg.* 11: 200-207.

Aleixo, A. 1921. E sporotrichose produzida por um esporotricho em forma de levedo, *Brasil Med.* 35: 2:283.

Arndt, G. 1909. Vorläufige Mitteilung über einen Fall von Sporotrichose der Haut, *Berlin. Klin. Woch.* 46: 1966-1968.

—. 1910. Beitrag zur Kenntnis der Sporotrichose der Haut, mit besonderer Berücksichtigung der Lymphangitis sporotrichotica. Experimentelle Sporotrichose, *Derm. Zeitschr.* 17: 24-53, 171-207, *Pls. 1, 2.*

Aroeira Neves. 1929. Contribuição ao estudo da esporotrichose familiar, *Brasil Med.* 43: 92-94.

Aschieri, Eugenia. 1929. Un Sporotrichum nuovo parassita dell'uomo, *Atti Ist. Bot. R. Univ. Pavia* IV, 1: 199-222, *8 figs.*

Auché, B. & A. LeDantec. 1894. Étude d'une nouvelle mucédinée pyogène parasite de l'homme (variété Botrytis), *Arch. Méd. Exp.* I, 6: 853-861, *4 figs.*

Ballagi, Stepan. 1932. Mykologische Beschreibung der Acremoniosis, *Arch. Derm. Syphilis* 166: 405-407, *2 figs.*

Basile, Giovanni. 1915. Sporotricosi sperimentale con particolare riguardo alla oto-rino-laringologia, *Ann. di Clin. Med.* 6: 264-294, *Pls. 1-3.*

Battaglia, Mario. 1912. Contributo allo studio delle sporotricosi, *Ann. Med. Nav. Colon.* **18**: 2:1-11.

Bedell, Arthur J. 1914. A case of chronic sporotrichosis of the eye, *Ann. Ophthamol.* **23**: 605-617, *5 figs.*

Bellucci, Luigi. 1925. Di alcuni importanti reperti micotici in oto-rino-laringologia (Acremonium tonsillare—Ozena nasale—Otite media da Sterigmatocystis ochracea), *Atti R. Accad. Fisiocrit. Siena* IX, **17**: 17-46, *16 figs.* [same title, *Arch. Ital. Otol.* **37**: 1-21, *3 pls.*, 1926].

Benedek, Tibor. 1926. Beitrag zur Kenntnis der rein epidermal Sporotrichosen. Dermo-epidermitis sporotrichotica verursacht durch eine neue Art von pathogenen Sporotrichum: Sporotrichum lipsiense nov. spec. unter besonderer Berücksichtigung der Serumdiagnose und der experimentellen Sporotrichose, *Derm. Woch.* **83**: 1695-1703; 1733-1738; 1770-1777; 1803-1807; 1824-1827.

Benham, Rhoda W. & Beatrice Kesten. 1932. Sporotrichosis; its transmission to plants and animals, *Jour. Infect. Dis.* **50**: 437-458, *15 figs.*

Berti, Giuseppe. 1922. Ricerche sperimentali sull'azione tossica del dello Sporotrichum Beurmanni, *Riv. Biol.* **4**: 44-50.

Beurmann, Lucien de. 1912. On sporotrichosis [translated by R. W. MacKenna], *Brit. Med. Jour.* **2**: 289-296.

—. 1912. Une forme nouvelle de sporotrichose. Elephantiasis sporotrichosique gommeux, ou pied de Madura sporotrichosique, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **34**: 621-628, *1 fig.*

—. 1914. Un cas de sporotrichose osseuse chronique à forme rhumatoïde avec gomme mammaire spontanément ouverte . . . *Bull. Mém. Soc. Méd. Hôp. Paris* III, **38**: 379-384.

Beurmann, Lucien de, Brodier and Gastou. 1907. Sporotrichose gommeuse disseminée avec lésions laryngées, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 1060-1069.

Beurmann, Lucien de & H. Gougerot. 1906. Les sporotrichoses hypodermiques, *Ann. Derm. Syphiligr.* IV, **7**: 837-864; 914-922; 993-1006.

—. 1907. Etiologie et pathogénie de la sporotrichose, *Tribune Méd.* **40**: 693-696.

—. 1907. Sixième cas de sporotrichose sous-cutanée et cutanée, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 309-313.

—. 1907. Les sporotrichoses sous-cutanées, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 302-305.

—. 1907. Sporotrichoses tuberculoïdes, *Ann. Derm. Syphiligr.* IV, **8**: 497-544; 603-635; 655-679.

—. 1907. Associations morbides dans les sporotrichoses. Onzième observation de sporotrichose; syphilis, tuberculose et sporotrichose, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 591-596. 12^e observation, *Ibid.* **24**: 596-610.

—. 1908. Sporotrichoses américaines. Diffusion du Sporotrichum Beurmanni, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **25**: 733-741.

—. 1909. Comparaison des sporotrichoses et des infections cocciennes. Sporotrichose aiguës et subaiguës disséminées. Sporotrichomes à évolution phlegmasique, *Ann. Derm. Syphiligr.* IV, **10**: 81-98.

—. 1910. Comparaison du Sporotrichum Jeanselmei et des Sporotrichum voisins, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **30**: 818-823.

—. 1910. Importance pratique du diagnostique de la sporotrichose et des autres mycoses facilité et difficulté de ce diagnostic, *Rev. Méd. Hyg. Trop.* **7**: 185-197.

—. 1910. Sporotrichoses nord-américains, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **30**: 798-818.

—. 1911. État actuel de la question des Sporotrichoses—Les progrès accomplis—Les discussions botaniques, interêt pratique, pronostique, thérapeutique et economique. Interêt doctrinal des sporotrichoses, *Arch. Derm. Syphilis* **110**: 25-74.

—. 1911. Les Sporotrichum pathogènes. Classification botanique, *Arch. de Parasitol.* **15**: 5-109, *Pls. 1-5.*

*—. 1912. L' état actuel de la question des mycoses, *Biol. Méd.* **10**.

—. 1912. Les Sporotrichoses. Paris, Felix Alcan. 825 pp., *8 pls., 181 figs.*

Beurmann, Lucien de, H. Gougerot & Vaucher. 1907. Notes sur les sporotrichoses généralisées expérimentales . . . *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 1000-1008.

—. 1907. Note sur l'histologie des follicules sporotrichosiques expérimentaux, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 1009-1013.

—. 1908. Epididymite, orchite et vaginite sporotrichosique. Contribution à l'étude des sporotrichoses internes, *Ann. Derm. Syphiligr.* IV, **9**: 465-479.

—. 1908. Orchite sporotrichosique du rat. Épreuve diagnostique, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **25**: 837-840.

—. 1908. La sporotrichose expérimentale du rat. Étude histologique de quelques localisations, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **25**: 800-837.

—. 1908. Sporotrichose expérimentale généralisé du chien, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **26**: 9-23.

—. 1908. Sporotrichose expérimentale du lapin, caverne pulmonaire gomme rénale. Sporotrichome hypertrophique du caecum. Sporotrichose verruqueuse cutanée, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **26**: 61-74.

—. 1908. Hérédo-sporotrichose expérimentale, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **26**: 876-880.

—. 1909. Sporotrichose expérimentale du chat, *C. R. Soc. Biol.* **66**: 338-340.

—. 1909. Sporotrichoses cutanées du chat, *C. R. Soc. Biol.* **66**: 370-372.

—. 1909. Sporotrichoses expérimentales. Sporotrichoses torpides chroniques. Sporotrichoses curables, *C. R. Soc. Biol.* **66**: 597-599.

—. 1909. Sporotrichose d'origine alimentaire, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **27**: 909-917.

—. 1909. Sporotrichose osseuse et ostéoarticulaire, *Rev. Chirurg.* **39**: 661-695.

Beurmann, Lucien de & Louis Ramond. 1903. Abcès sous-cutanés multiples d'origine mycosique, *Ann. Derm. Syphiligr.* IV, **4**: 678-685.

Blaisdell, J. Harper. 1917. Sporotrichosis, a clinical and histopathological report of the first case to be published in New England, *Jour. Cutan. Dis.* **35**: 452-456, *4 figs.*

Blanchetière, A. 1909. Contribution à l'étude biologique de quelques variétés du genre Sporotrichum pathogène pour l'homme, *Thèse Paris* **268**: 1-103.

Blanchetière, A. & H. Gougerot. 1909. Actions chimiques produites par le Sporotrichum Beurmanni, *C. R. Soc. Biol.* **66**: 202-204.

Bloch, Bruno. 1909. Die Sporotrichose, *Beih. Med. Klin.* **5**: 179-202, *1 pl.*

Boedijn, K. B. & A. Steinmann. 1931. Les espèces des genres Helicobasidium et Septobasidium des Indes Néerlandaises, *Bull. Jard. Bot. Buitenzorg*, III, **11**: 165-219, *Pls. 14-18, 31 figs.*

Boggs, Thomas R. & Hiram Fried. 1925. Sporothrix infection of the large intestine and finger nails, *Bull. Johns Hopkins Hosp.* **37**: 164-169, *4 figs.*

Bois, Charles du. 1912. Sporotrichose généralisée à gommes disseminées multiples et non ouvertes, *Rev. Méd. Suisse Romande.* **32**: 757-763, *2 figs.*

Bolognesi, Guiseppe. 1914. Sporotricosi ossea sperimentale, *Pathologica* **6**: 509-511, *4 figs.*

—. 1915. Sporotricosi articolare sperimentali, *Pathologica* **7**: 55-57, *3 figs.*

—. 1916. Sporotricosi renale sperimentale, *Policlinico Sez. Chirurg.* **23**: 129-142.

Bonnet, L. M. 1910. Sporotrichose à manifestations multiples, gommes cutanées, gomme musculaire, arthropathie du genou simulante une arthropathie syphilitique, *Bull. Soc. Franç. Derm. Syphiligr.* **21**: 347-350.

—. 1911. Sporotrichose, *Lyon Méd.* **116**: 114, 115.

—. 1911. Contribution à l'étude expérimentale de la sporotrichose, *Rev. de Méd.* [Mém. en honneur de R. Lépine] 99-102.

—. 1912. Sporotrichose primitive du calcaneum, *Ann. Derm. Syphiligr.* V, **3**: 152-162, *2 figs.*

Boppe & A. Orticoni. 1913. Sporotrichose d'un metacarpien, *Rev. Méd. de l'Est* 45: 402-405.

*Boucher, Humbert & J. Carougeau. 1922. Premier cas de sporotrichose à Sporotrichum Gougeroti observé sur un cheval á Madagascar, *Rev. Gén. Méd. Vét.*

Brainos, A. 1920. Sporotrichose des organes génitaux méconnue, *Paris Méd.* 10: 247, 248.

Breda, A. & M. Vivaldi. 1915. La sporotrichose nella regione veneta, *Atti R. Ist. Veneto Sci. Lett. Arti.* 75: 407-413.

Brink, K. B. M. Ten. *See* Ten Brink, K. B. M.

Brocq-Rousseu, D. 1914. Étude de l'Acremonium Potroni Vuillemin, *Rev. Gén. Bot.* 26: 150-156.

Brumpt, E. & Maurice Langeron. 1910. Un nouveau champignon parasit de l'homme, le Sporotrichum Jeanselmei n. sp., *Bull. Mém. Soc. Méd. Hôp. Paris* III, 29: 792-796, *1 fig.; Ibid.* III, 29: 824.

*Brunaud. 1888. Nouveaux fragments mycologiques, 2 séries, Bordeaux.

Büechl, Cornel. 1933. Ein Beitrag zur Kasuistik der Sporotrichose, *Inaug. Diss. Med. Fak. Univ. München,* 15 pp.

Burlew, J. M. 1909. Subcutaneous abscess caused by the Sporothrix Schenckii. Report of a case, *S. California Practitioner* 24: 1-3.

Buschke, A. & E. Langer. 1928. Die Sporotrichose, *Handbuch. Path. Mikroorg.* [Kolle & Wassermann, ed. 3] 5: 401-450, *2 pls., 9 figs.*

Carougeau, 1909. Sur une nouvelle mycose sous-cutanée des équidés, *Jour. Méd. Vét. Zootech.* 60: 8-22, 75-90, 148-153.

Castellani, Aldo. 1908. Tropical dermatomycoses, *Jour. Trop. Med. Hyg.* 11: 260.

Chipman, Ernest Dwight. 1913. The newer cutaneous mycoses, *Jour. Amer. Med. Ass.* 61: 407-412, *3 figs.*

Couch, John Nathaniel. 1933. The basidia of Septobasidium (Glenospora) Curtisii, *Jour. Elisha Mitchell Sci. Soc.* 49: 157-162, *Pls. 10, 11.*

Cregor, Frank W. 1922. Sporotrichosis, *Jour. Amer. Med. Ass.* 79: 812-815, *Figs. 1-5.*

Crutchfield, Earl D. 1923. Sporotrichosis, *Arch. Derm. Syphilol.* 7: 226-233.

*Cruz Correa, J. de la. 1913. Esporotrichosis Laríngea. Importancia de su diagnostico, *Semana Méd.* 19:

D'Agata, Giuseppe. 1915. Contributo sperimentale allo studio dell' infezione sporotricosica, *Lo Sperimentale* 69: 697-722, *3 pls.*

—. 1921. Sporotrichotisches Granulom und vitale Färbung, *Arch. Path. Anat. Phys.* [Virchow] 230: 667-673, *3 figs.*

Danlos & Ch. Flandin. 1909. Sporotrichose cutanée simulant l'epithelioma ou la tuberculose papillomateuse; sporotrichose de la portion cartilagineuse de la cloison des fosses nasales, *Bull. Soc. Franç. Derm. Syphiligr.* 20: 251-253.

Davis, Benjamin F. 1914. Report of a case of sporotrichosis, *Surg. Gyn. Obstet.* 19: 490, 491.

Davis, David John. 1913. Interagglutination experiments with various strains of Sporothrix, *Jour. Infect. Dis.* 12: 140-143.

—. 1913. Morphology of Sporothrix Schenckii in tissues and artificial media, *Jour. Infect. Dis.* 12: 452-458, *3 figs.*

—. 1914. The formation of chlamydospores in Sporothrix Schenckii, *Jour. Infect. Dis.* 15: 483-486.

—. 1915. Chromogenesis in Sporotricha, *Jour. Infect. Dis.* 17: 174-182, *Pls. 2, 3.*

—. 1919. The effect of potassium iodide in experimental sporotrichosis, *Jour. Infect. Dis.* 25: 124-131, *2 figs.*

—. 1921. The identity of American and French sporotrichoses, *Univ. Wisconsin Studies Sci.* 2: 104-130.

Eisenstaedt, J. S. 1918. Sporotrichosis resembling tuberculosis cutis, *Jour. Am. Med. Ass.* 71: 726-728, *3 figs.*

Emerson, C. P. 1918. Mould infections, *Med. Rec.* 93: 1067.

Escomel, E. 1923. À propos de deux cas de sporotrichose pharyngée observés à Aréquipa (Pérou), *Arch. Internat. Laryngol., Oto-rhinol. Broncho-oesophagoscopie.* 2: 12-14.

—. 1924. Essai sur la parasitologie d'Aréquipa (Pérou), *Bull. Soc. Path. Exot.* 17: 906-925 [mycoses pp. 917-924].

—. 1928. Acerca de dos casos de esporotrichosis faríngea en Arequipa, Perú, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 4: 520-522.

Ferrand, M. & H. Rabeau. 1923. Sporotrichose végétante et verruquense du nez, simulante la tuberculose verruqueuse, *Ann. Derm. Syphiligr.* VI, 4: 345-347, *1 fig.*

Fielitz, H. 1910. Ueber eine Laboratoriums infektion mit Sporotrichon Beurmanni, *Centralbl. Bakt.* I, 55: 361-370, *1 pl.* [*Berlin. Klin. Woch.* 47: 949].

*Fiorito, G. & R. Benedetti. 1924. Contributo alla diagnosi della sporotrichosi, *Ann. Med. Nav. Colon.* 30? [1]:211.

Foerster, Harry R. 1924. Sporotrichosis, *Am. Jour. Med. Sci.* 167: 54-76, *4 figs.*

Fontoynont, Maurice. 1922. Sur quelques lésions mycosiques observées à Madagascar, *Bull. Mém. Soc. Chirurg. Paris* 48: 439-442.

Fontoynont, Maurice & Humbert Boucher. 1923. Contribution à l'étude des mycoses de Madagascar, *Ann. Derm. Syphiligr.* VI, 4: 209-235, 318-344, *10 figs.*

Fontoynont, Maurice & J. Carougeau. 1922. Abcès sousdermiques et gommes ulcérées produits par le Sporotrichum Carougeaui Langeron 1913, associé à la tuberculose chez un enfant Malgache, *Bull. Soc. Path. Exot.* 15: 444-453.

Forbus, Wiley D. 1927. Pulmonary sporotrichosis, *Am. Rev. Tuberculosis* 16: 598-627.

Foulerton, Alexander G. R. 1901. On the morphology and pathogenic action of Sporothrix Schencki, *Trans. Pathol. Soc. London* 52: 259-270, *Pl. 12.*

Gain, Edmond & D. Brocq-Rousseu. 1913. Résistance à l'iodure de potassium de L'Acremonium Potronii Vuillemin, *C. R. Soc. Biol.* 74: 46.

Gastou, & Bonneau. 1912. Panaris sporotrichosique gangréneux par piqûre d'une plante soidisant vénéneuse et sporotrichose lymphangitique gommeuse, *Bull. Soc. Franç. Derm. Syphiligr.* 23: 253, 254.

Gougerot, H. 1907. Diagnostic de la syphilis et des sporotrichoses sous-cutanées et cutanées, *Ann. Mal. Vén.* 2: 161-191, *1 pl.*

—. 1909. Formes cliniques de la sporotrichose de de Beurmann, *Gaz. Hôp. Civ. Milit.* 82: 537-546, 581-588.

—. 1912. Anatomie pathologique des mycoses, *Arch. Méd. Exp. Anat. Path.* 24: 738-748.

—. 1913. Sporotrichosen. Die pathogenen Sporotrichen und die Sporotrichosen, *Handb. Path. Mikroorg.* [Kolle & Wassermann] ed. 2, 5: 211-266, *2 pls.*

—. 1914. Anatomie pathologique des mycoses (Vue d'ensemble), *Premier Cong. Internat. Path. Comp.* 2: 202-210.

Gougerot, H. & A. Blanchetière. 1909. Endotoxines sporotrichosiques [I]. Action pathogène des corps microbiens tués et des corps résiduels, *C. R. Soc. Biol.* 67: 247, 248. [II] Sporo-éthérines, sporo-chloroformines, *Ibid.* 67: 352-354.

Gougerot, H. & Caraven. 1908. Sporotrichose spontanée du chien. Gommes hypodermiques péritonite granuleuse et gommes hepatiques, *Presse Méd.* 16: 337-341.

Gougerot, H. & Clara. 1917. Dermatose végétante et suppurée, nodules à suppuration centrale et placards végétants à suppuration en écumoire, *Ann. Méd. Paris* 4: 279-294, *3 figs.*

Grandinetti, Líbia. 1934. Contribuiçao para o estudo da esporotricose em São Paulo, *These Fac. Med. São Paulo,* 72 pp., *8 pls.*

*Greco, Nicolas V. 1907. Sporotricosis linfangitica nodular vegetante, *Argentina Méd.*

*—. 1908. Biologia del Sporotrichum Schenckii-Beurmanni, *Argentina Méd.* Also *Rev. Dermatologica.* 1: 78.

*—. 1909. Esporotrichosis y blastomicosis americanas, *Argentina Méd.*

Gregoriis, Antonio de. 1926. Primeros casos de esporotrichosis observados en el norte de la República Argentina, *An. Depart. Nac. Higiene.* 26: 103-106.

Grigorakis, Leonidas. 1924. Les champignons parasites du syndrome de Beurmann et Gougerot et l'espèce Rhinocladium Gougeroti, *Bull. Soc. Myc. France* **40**: 272-276, *4 figs.* [1925].

—. 1927. Sur un nouveau dermatophyte du genre Aleurisma, *C. R. Soc. Biol.* **97**: 492-493.

—. 1932. De l'action de l'éther sur les micro-végétaux parasites du tissu animal (facteurs de virulence, vitalité, dégradation et mutation), *C. R. Acad. Sci.* **195**: 555, 556.

Grigsby, C. M. & Ramsay H. Moore. 1922. Case of sporotrichosis, *Southern Med. Jour.* **15**: 684-687.

Grigorakis, Leonidas, A. Fayet & J. Magrou. 1926. Sur un nouveau dermatophyte du genre Aleurisma, *C. R. Soc. Biol.* **95**: 649-651.

Gross, Georges & L. Heuilly. 1911. Note sur un cas de sporotrichose, *Rev. Méd. de l'Est* **43**: 65-72.

—. 1911. Un cas de sporotrichose généralisée à forme gommeuse disséminée, *Rev. Méd. de l'Est* **43**: 141, 142.

Grütz, Otto. 1925. Beitrag zu den seltenen Mycose. Ueber eine durch Acremonium verursachter Pilzerkrankung, *Derm. Woch.* **80**: 765-774.

—. 1925. Über eine eigenartige Form von Sporotrichose mit Befund von Sporotrichum Gougeroti, *Derm. Woch.* **81**: 1660-1664; 1709-1716.

—. 1928. Sporotrichosen und verwandte Krankheiten, *Handb. Haut Geschlechtskr.* [Jadassohn] **11**: 797-799.

Hamburger, Walter W. 1912. Sporotrichosis in man with a summary of the cases reported in the United States and a consideration of the clinical varieties and the important factors in the differential diagnosis, *Jour. Am. Med. Ass.* **59**: 1590-1595.

—. 1914. Sporotrichosis in the United States, *Illinois Med. Jour.* **25**: 99-102.

Hanriot & Weis. 1932. Ostéite sporotrichosique fistulisée du tibia, *Bull. Soc. Franç. Derm. Syphiligr.* [**43**:] 426-429, *1 fig.*

Harker, Harry J. 1911. A case of sporotrichosis in man, *Jour. Am. Med. Ass.* **56**: 1312.

Haynes, R. H. & S. L. Cherry. 1915. Case of sporotrichosis: the first recorded in West Virginia, *West Virginia Med. Jour.* **9**: 303.

Hecht, Hugo. 1913. Ein Fall von Sporotrichosis, *Arch. Derm. Syphilis* **116**: 846-851, ***Pl. 40.***

Hektoen, Ludvig & C. F. Perkins. 1900. Refractory subcutaneous abscesses caused by Sporothrix Schencki, nonpathogenic fungus, *Jour. Exp. Med.* **5**: 77-89, ***Pls. 2, 3.***

Hodara, Menahem & Fuad Bey. 1911. Un cas de septicémie sporotrichosique, *Arch. Derm. Syphilis* **110**: 387-392.

—. 1912. Histologische Untersuchung bei drei Fällen von Sporotrichose, *Derm. Woch.* **54**: 50-54, *2 pls.*

Hoffmann, E. 1910. Über Sporotrichose (experimentelles und subcutanes Sporotrichon beim Affen, verbesserte Färbung der Pilze im Schnitt), *München. Med. Woch.* **57**: 608, 609.

*Hude. 1925. Sporotrichose primitive de la conjonctive avec localisation secondaire amygdalienne au cours du traitement, *Bull. Soc. Ophthalm. Paris* 379, 380.

Hügel, G. 1910. Ein Fall von Sporotrichose, *Arch. Derm. Syphilis* **102**: 95-99, *Pl. 6.*

Hyde, James Nevins & D. J. Davis. 1910. Sporotrichosis in man with incidental consideration of its relation to mycotic lymphangitis in horses, *Jour. Cut. Dis.* **28**: 321-352, *Pls. 36-45.*

Jeanselme, E. & Paul Chevallier. 1910. Un cas de sporotrichose à foyers multiples, *Bull. Soc. Franç. Derm. Syphiligr.* **21**: 190-192.

—. 1910. Sporotrichoses à foyers multiples, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **29**: 784-792.

Jessner, Max. 1922. Experimentelle und histologische Studien über Rattensporotrichose, *Klin. Woch.* **1**: 2428, 2429.

—. 1923. Experimentelle und histologische Studien über Hautsporotrichose an Ratten, *Arch. Derm. Syphilis* **144**: 138-168.

Jocqs, R. 1911. La sporotrichose oculaire, *La Clinique Ophtalmol.* **17**: 62-68 [n.s. 4].

Jousset-Moure, 1908. Sporotrichose du tibia ayant simulé une ostéomyélite chronique et necessité quatre interventions chirurgicales. Diagnostique par la sporoagglutination et la réaction de fixation, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 26: 738-742.

—. 1909. Adénite sporotrichosique, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 27: 133-138.

Kawatsure, Shûji. 1933. Tierexperimentelle Untersuchungen über die Erreger von sogenannten amerikanischen Blastomykosen: Scopulariopsis americana, Aleurisma tulanense und Coccidioides immitis, *Arch. Derm. Syphilis* 169: 173-199, *11 figs.*

Kesten, Beatrice, Bailey K. Ashford, Rhoda W. Benham, C. W. Emmons & M. C. Moss. 1932. Fungus infections of the skin and its appendages occurring in Porto Rico. A clinical and mycologic study, *Arch. Derm. Syphilol.* 25: 1046-1057, *5 figs.*

Kesten, Beatrice M. & Hans Martenstein. 1929. Experimental sporotrichosis, cutaneous and intracardial inoculation: a preliminary report, *Arch. Derm. Syphilol.* 20: 441-444.

King, Howard. 1927. Sporotrichosis with report of an unusual case, *Southern Med. Jour.* 20: 541-546, *8 figs.*

Landrieu, Marcel. 1912. Les Mycoses oculaires, *Thèse de Paris*, 136 pp.

Langeron, Maurice. 1913. Un nouveau Sporotrichum malgache Sporotrichum Carougeaui, n. sp., *Arch. de Parasitol.* 16: [never published in this journal due to war, but published in 1922, q. v., Cited by Brumpt, *Précis de Parasitologie*, ed. 2, 1913, which is probably place of publication of the new species].

—. 1922. Un nouveau Sporotrichum malgache: Sporotrichum Carougeaui Langeron 1913, et rémarques sur les Sporotriches, *Bull. Soc. Path. Exot.* 15: 453-459, *2 figs.*

Lapersonne, F. de. 1912. Sporotrichose oculaire, *Presse Méd.* 20: 93-95, *3 figs.*

Lapersonne, F. de & Bourdier. 1914. Sporotrichose oculaire expérimentale chez le chien, *Premier Congr. Internat. Path. Comp.* 2: 193-200.

Lawless, Theodore Kenneth. 1924. Ein Experimenteller Beitrag zur Pathologie der Sporotrichose, *Derm. Zeitschr.* 40: 257-288, *Pls. 3-8.*

—. 1930. The diagnosis of sporotrichosis, *Arch. Derm. Syphilol.* 22: 381-388.

Leger, Marcel, G. L. Huchard & A. Baury. 1922. Un cas de sporotrichose pulmonaire, *Bull. Soc. Path. Exot.* 15: 357-363.

Legry, Sourdel & Velter. 1911. Sporotrichose gommeuse disseminée avec lésions oculaires (iridocyclite et gommes del'iris) et spina ventosa sporotrichosique, *Bull. Mém. Soc. Méd. Hôp. Paris* 32: 124-132.

Lehner, Emmerich. 1932. Über ein Fäll von Acremoniosis, *Arch. Derm. Syphilis* 166: 399-404.

Leinati, Fausto. 1929. Ulcere micotiche sperimentali dello stomaco, *Atti R. Accad. Fisiocrit. Siena* X, 4: 147-223, *23 figs.*

Lesné & Monier Vinard. 1907. Abcès sous-cutanés chroniques et multiples dus à un champignon filamenteux. Sporotrichose sous-cutanée, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 24: 268-277, *1 fig.*

Letulle, Maurice & R. Debré. 1908. Sporotrichose de la peau, de la bouche, du pharynx, du larynx et de la trachée, *Bull. Mém. Soc. Méd. Hôp. Paris* III, 25: 379-396.

Link, Heinrich Fridrich. 1815. Observationes in Ordines plantarum naturales. Dissert. secunda. Sistens nuperas de Mucedinum et Gastromycorum ordinibus observationes, *Mag. Ges. Naturf. Freunde Berlin* 7: 25-45.

—. 1818. Über die Gattung Sporotrichum, *Jahrb. Gewachskunde* 1: 163-183 [vol. title page dated 1820 but first number issued 1818].

Lipiński, Witold. 1924. Sporotrichoza błon śluzowych spowodowana przez nowy gatunek Sporotrichum (Sporotrichum cracoviense). [**Polska Gazeta Lekarska* 3.] *Medycyna Doświadczalna i Społeczna* 2: 153-169, *7 figs.*

Longo, Francesco. 1930. Sporotricosi cutanea, *Arch. Ital. Derm. Sifiligr. Venereol.* 5: 385-390, *1 fig.*

Lutz, Adolf & Alfonso Splendore. 1907. Sopra una micosi osservata in uomini e topi. [Mus decumanus] Contribuzione alla conoscenza delle cosi dette Sporotrichosi, *Ann. Ig. Sperim.* 17: 581-606, *Pls. 13-16.*

—. 1907. Über eine bei Menschen und Ratten beobachtete Mykose. Ein Beitrag zur Kenntnis der sogenannten Sporotrichosen, *Centralbl. Bakt.* I, 45: 631-637, *Pls. 1-4.*

*Mantarro. 1933. Contributo allo studio della sporotricosi umana. Pubblicazione degli allievi in onore del Prof. Umberto Mantegazza [725 pp.] Tipografia Bianchi, Pavia [rev. *Giorn. Ital. Derm. Sifilol.* 74: 1702].

Mackinnon, Juan E. 1931. Estudio parasitológico de tres casos de esporotricosis, *Arch. Soc. Biol. Montevideo, Suppl. Fasc.* 5: 1320-1327.

McLean, Edward H. 1917. An additional case of sporotrichosis, *Jour. Am. Med. Ass.* 69: 1774, 1775.

Marengo, G. 1926. Si di un caso di Acremoniosi cutanea, *Arch. Ital. Derm. Sifiligr. Venereol.* 1: 348-354, *1 fig.*

Mariani, G. 1923. Pleuromediastinite infiltrativa diffusa con forme secondarie gommose osteoperiostee cutanee; esito letale; probabile origine micosica del processo; isolamento di un fungo patogeno del genere Trichosporium Tricosporiosi, *Giorn. Ital. Mal. Ven. Pelle* 64: 741-758, *4 pls.*

Massia, G. & Leonidas Grigorakis. 1924. Sur une épidermophytie occasionnée par une espèce nouvelle: Aleurisma lugdunense (Vuillemin in litt. 1924), *C. R. Soc. Biol.* 91: 1381-1383.

Matruchot, Louis. 1910. Les champignons pathogènes, agents des sporotrichoses, *C. R. Acad. Sci.* 150: 543-545.

Meyer, K. F. 1915. The relation of animal to human sporotrichosis (Studies on American sporotrichosis III), *Jour. Am. Med. Assn.* 65: 579-585.

—. 1915. Epizootic lymphangitis and sporotrichosis (Studies on American sporotrichosis II), *Am. Jour. Trop. Dis. Prevent. Med.* 3: 144-163.

Meyer, K. F. & J. A. Aird. 1915. Various sporotricha differentiated by the fermentation of carbohydrates (Studies on American sporotrichosis I), *Jour. Infect. Dis.* 16: 399-409.

Mibelli, A. 1910. Osservazione di un caso di sporotricosi cutanea, *Giorn. Ital. Mal. Ven. Pelle* 61: 422-431.

Michel, Louis & Georges Thiry. 1913. Un cas de Acremoniose (Acremonium Potronii Vuillemin 1911), *Rev. Méd. de l'Est* 45: 298-300.

Monacelli, Mario. 1926. Un caso di sporotricosi linfangitica gommosa, *Arch. Ital. Derm. Sifiligr. Venereol.* 1: 393-423.

Montpellier, J. & A. Catanei. 1927. Formes cliniques, histologie pathologique, parasitologie et diagnostique des mycétomes observés en Algérie, *Arch. Inst. Pasteur d'Algérie* 5: 489-508, *Pls. 1, 2, 5, Figs. A, B, 3, 4.*

Montpellier, J., A. Catanei & P. Clapier. 1927. Étude d'un mycétome à grains noirs dû à Glenospora Clapieri Catanei, 1927, *Bull. Soc. Path. Exot.* 20: 502-511, *4 figs.*

Montpellier, J., A. Catanei & R. Lefranc. 1932. Un nouveau cas de sporotrichose humaine observé en Algérie, *Bull. Soc. Path. Exot.* 25: 297-299.

Moore, Josiah J. & David John Davis. 1918. Sporotrichosis, following mouse bite, with certain immunologic data, *Jour. Infect. Dis.* 23: 252-265, *3 figs.*

Morales, R. 1931. Un cas de lymphangite sporotrichosique au Guatemala, *Ann. Parasitol. Hum. Comp.* 9: 366, 367, *3 figs.*

Morax, V. 1914. Uvéite sporotrichosique avec gomme sporotrichosique épisclérale secondaire. Absence de tout autre localisation sporotrichosique décelable, *Ann. d'Occulistique* 152: 273-278.

Motta, Roberto. 1926. Miceti isolati da tumori della faringe e della laringe, *Atti R. Accad. Fisiocrit. Siena* IX, 17: 655, 656.

Mount, Louis B. 1932. Sporotrichosis, with a report of a rather unusual case, *Arch. Derm. Syphilol.* 25: 528-534, *1 fig.*

Mourão, Mario. 1922. Um caso de mycose—sua importancia practica, *Brasil Med.* 36: 2: 335-337.

Neves, Aroeira. See Aroeira Neves.

Nicolas, J., J. Gaté & D. Dupasquier. 1923. Gommes tuberculeuses sporotrichoïdes sans adenopathie, *Paris Méd.* 47: 245-249.

Nieuwenhuis, A. W. 1904. Tinea albigena, *Geneesk. Tijdschr. Nederlandsch Indië* 44: 561-580.

—. 1908. Tinea albigena. Het kweeken van haar schimmel en de infectieproef met deze, *Geneesk. Tijdschr. Nederlandsch Indië* 48: 35-51, *Pls. 1-3.*

—. 1908. Tinea albigena und die Zuchtung ihres Pilzes, *Arch. Derm. Syphilis* 89: 3-30, *Pls. 1-4.*

—. 1910. Individuality and heredity in a lower mould fungus, Trichophyton albiscicans, *Verhandel. K. Akad. Wetensch. Amsterdam* 13: 1: 550-566, *Pls. 1, 2.*

—. 1910. Method to cultivate microorganisms from one cell, *Verhandel. K. Akad. Wetensch. Amsterdam* 13: 1: 566-576, *Pls. 3, 4.*

Ofenheim, E. von. 1911. Sporotrichosis, *Lancet* 1: 659, 660.

Olson, G. M. 1912. A case of sporotrichosis in North Dakota. Probable infection from gophers, *Jour. Am. Med. Assn.* 59: 941.

Ota, Masao. 1925. Affinités du Trichophyton albiciscans Nieuwenhuis avec les aleuriosporés du genre Glenospora Berk. et Curt, *Ann. Parasitol. Hum. Comp.* 3: 79-84.

Ota, Masao & Shûji Kawatsure. 1933. Zur Ätiologie der echten und falschen Blastomykosen, besonders der Gilchristschen Krankheit, *Arch. Derm. Syphilis* 169: 149-172, *11 figs.*

Pacinotti, G. 1921. Colorazione dei microparasiti specifici nei granulomi prodotti da Sporotricum Beurmanni, *Riforma Med.* 37: 733, 734.

Page, Calvin Gates, Langdon Frothingham & James B. Paige. 1910. Sporothrix and epizootic Lymphangitis, *Jour. Med. Res.* 23: 137-150, *Pls. 3-7.*

Pasini, A. 1930. Oosporosi cutanea da Oospora D'Agathae, *Giorn. Ital. Derm. Sifilol.* 71: 990-999, *2 pls.*

Pautrier, L. M., Belot & Richon. 1912. Sporotrichose à lésions cutanées gommeuses et verruqueuses à la fois syphiloïdes et tuberculoides d'aspect. Volumineuse gomme osseuse, lésions de la muqueuse des fosses nasales, *Ann. Derm. Syphiligr.* V, 3: 163-170, *2 figs.*

Péneau, Henry. 1912. Cytologie du Sporotrichum Beurmanni, *C. R. Soc. Biol.* 73: 504-506.

Pereira, filho. 1929. Uma nova especie de Esporotrichado o Sporotrichum Fonsecai, *Rev. Med. Cirurg. Brasil* 37: 265, 266, *1 pl.* [English translation, 266, 267].

—. 1930. Sporotrichum Fonsecai e o diagnostico differencial dos esporotrichados, *Rev. Med. Cirurg. Brasil* 38: [3-21], *Pls. 1-24.*

Petruschky, J. 1913. Die pathogenen Trichomyceten und Trichobakterien Streptothrix, Cladothrix, Leptothrix, *Handb. Path. Mikroorg.* [Kolle & Wassermann], ed. 1, 5: 267-300, *1 pl.*

Pijper, Adrianus & B. Davidine Pullinger. 1927. An outbreak of sporotrichosis among South African Miners, *Lancet* 213: 914, 915, *2 figs.*

Pinoy, E. 1911. Formes du Sporotrichum Beurmanni dans les lésions humaines. Sa fructification à l'intérieur des capillaires, *C. R. Acad. Sci.* 152: 286-288.

—. 1913. Présentation de grains rouges et de grains noirs, *Bull. Soc. Path. Exot.* 6: 294-296.

Pinoy, E. & J. Magrou. 1911. Sur une methode de diagnostic possible de la sporotrichose par inoculation directe de pus au cobaye, *C. R. Soc. Biol.* 71: 387, 388.

Pitotti, Paolo. 1932. Un caso di acremoniosi cutanea, *Riforma Med.* 48: 1567, 1568, *2 figs.*

Pollacci, Gino. 1923. Miceti del corpo umano e degli animali III. Due nuovi ifomiceti parassiti, Acremoniella Perinii n. sp. Haplographium DeBellae-Marengoi Pollacci var. equinum n. var., *Riv. di Biol.* 5: 358-367, *3 figs.*

Potron, Maurice & Noisette, G. 1911. Un cas de mycose, *Rev. Med. de l'Est* 43: 132-139, 161-171.

Pringualt, E. & P. Vigne. 1921. Note sur un cas de Sporotrichose naturelle du rat, *Bull. Soc. Franç. Derm. Syphiligr.* 28: 342-344.

Pupo, João de Aguiar. See Aguiar Pupo, João de.

Quénu, E. 1914. De la sporotrichose mammaire, *Rev. Chirurg.* **49**: 585-603.

Quiroga, Ruperto. 1928. Esporotricosis por Rhinocladium Beurmanni, *Bol. Inst. Clín. Quirúrg. Univ. Buenos Aires* 4: 523-530, *2 figs.* [*4ta Reunión Soc. Argentina Pat. del Norte*].

Ragusin, Neocle & Juan Barillati. 1914. Un caso de esporotrichosis cutanea, *Revista Dermatológia* 2: 181-185, *2 figs.*

Rezende, Cassio de. 1918. Contribuição para o estudo da sporotrichose no Brasil, *Brasil Med.* 32: 33-36.

Rispal & Dalous. 1910. Contribution à l'étude de la morphologie et du développement du Sporotrichum Beurmanni, *Ann. Derm. Syphiligr.* V, **1**: 372-376.

Rothe, L. 1910. Über die Agglutination des Sporotrichon de Beurmann durch Serum von Aktinomykoserkranken, *Deutsch. Med. Woch.* **36**: 1: 30.

Ruebens-Duval, H. & Fage. 1907. Un nouveau cas de sporotrichose gommeuse cutanée et sous-cutanée avec ulcérations spontanées, *Bull. Mém. Soc. Méd. Hôp. Paris* III, **24**: 380-385.

Ruediger, Gustav F. 1912. Sporotrichosis in the United States, *Jour. Infect. Dis.* **11**: 193-206, *2 figs.*

Ruediger, Gustav F. & H. W. Miller. 1911. Sporotrichosis in North Dakota: report of a case, *Jour. Minnesota State Med. Assn. Northwestern Lancet* **31**: 507-513, *5 figs.*

Sartory, Antoine. 1915. Présence du Sporotrichum Beurmanni de Beurm. et Goug. sur un épi de blé, *C. R. Soc. Biol.* **78**: 740-742.

Sartory, Antoine, G. Blaque & E. Schulmann. 1918. Un cas de sporotrichose pulmonaire, *C. R. Acad. Sci.* **167**: 247-250.

Sartory, Antoine & A. Orticoni. 1913. Étude d'un Sporotrichum provenant d'une sporotrichose d'un metacarpien, *C. R. Soc. Biol.* **74**: 1133, 1134.

Sartory, Antoine, R. Sartory & Jacques Meyer. 1928. Sur un cas d'onychomycose produit par le Sporotrichum Beurmanni de Beurmann et Ramond, *Bull. Acad. Méd.* [Paris] III, **99**: 386-388.

Sartory, Antoine, R. Sartory, Marcel Meyer & Jacques Meyer. 1930. Contribution à l'étude des mycoses osseuses: une mycose osseuse primitive à Sporotrichum Carougeaui Langeron, *Bull. Acad. Méd.* [Paris] III, **104**: 98-101.

—. 1932. Contribution à l'étude des sporotrichoses osseuses, *Ann. Inst. Pasteur* **49**: 480-491, *5 figs.*

—. 1933. Un nouveau cas de sporotrichose osseuse, *C. R. Soc. Biol.* **114**: 1285-1287.

Schenck, B. R. 1898. On refractory subcutaneous abscesses caused by a fungus possibly related to the Sporotricha, *Johns Hopkins Hosp. Bull.* **9**: 286-290, *2 pls.*

Schulmann, Ernest & A. Masson. 1918. Étude clinique d'un cas de sporotrichose pulmonaire, *Bull. Mém. Soc. Méd. Hôp. Paris* **42**: 776-780.

Segré, Giorgio. 1914. Su di un caso di sporotricosi cutanea, *Giorn. Ital. Mal. Ven. Pelle* **55**: 893-910, *1 pl.*

*—. 1920. Sporotricosi da Sporotrichum Gougeroti, *Atti Soc. Lombarda Sci. Med. Biol.* **9**:

Segura, E. V. 1913. Considérations sur les mycoses des muqueuses des voies respiratoires et digestives supérieures, *Arch. Internat. de Laryngol.* **36**: 48-66, *1 pl.*

Singer, J. J. 1928. Pulmonary sporotrichosis, *Am. Rev. Tuberculosis* **18**: 438-443.

*Solari, Emilio F. 1917. Primer caso de micetoma o pie de Madura observado en Rosario de Santa Fé, *Tesis, Buenos Aires* [long review *Brasil Med.* 32: 142, 143, 1918, by Parreiras Horta, see also *Semana Méd.* No. 47, 1917].

Spillmann, Louis & Gruyer. 1908. Deux cas de sporotrichose (sporotrichose syphiloïde gommeuse et sporotrichose tuberculoïde de type nodulaire, *Ann. Derm. Syphiligr.* IV, **9**: 578-581.

Splendore, Alfonso. 1908. Uma nova especie de cogumelo pathogenico do homen, *Rev. Soc. Sci. São Paulo* 3: 62.

—. 1909. Sporotrichoses américaines, *Brasil Med.* **23**: 361-365, *2 pls.*

—. 1910. Sporotricosi americane, *Ann. Ig. Sperim. N. S.* 20: 89-99, *Pls. 2, 3.*

Spoor, A. 1917. Sporothricosis: report of a case, *Jour. Am. Med. Assn.* 68: 1548.

Stein, Robert. 1909. Die Sporotrichosis de Beurmann und ihre Differentialdiagnose gegen Syphilis und Tuberkulose, *Arch. Derm. Syphilis* 98: 1-34, *Pls. 1-3.*

Steward, W. B. 1911. A case of sporotrichosis, *Jour. Am. Med. Assn.* 57: 482.

Sutton, J. N. 1911. A clinical study of sporotrichosis with a report of four cases, *Jour. Am. Med. Assn.* 56: 1309, 1310, *4 figs.*

Sutton, Richard L. 1911. Sporotrichosis in man and in the horse, *Boston Med. Surg. Jour.* 164: 179-181.

—. 1913. The occasional clinical resemblance of blastomycosis and syphilis to sporotrichosis, *Jour. Am. Med. Assn.* 60: 115-117.

—. 1914. Sporotrichosis in the Mississippi basin, *Jour. Am. Med. Assn.* 63: 1153-1155, *6 figs.*

Taylor, Kenneth. 1913. Sporotrichum Schenckii, *Jour. Am. Med. Assn.* 60: 1142-1145, *2 figs.*

TenBrink, K. B. M. 1916. Sporotrichose, *Geneesk. Tijdschr. Nederlandsch Indie* 56: 178-195, *16 figs.*

—. 1918. Sporotrichose in Nederlandsch Indië *Nederlandsch. Tijdschr. Geneesk.* 62: 1A: 5-10, *24 figs.*

Tennant, C. E. & W. S. Dennis. 1921. Sporotrichosis: a case report, *Colorado Med.* 18: 165, 166, *2 figs.*

Thibierge, Georges & Pierre Gastinet. 1909. Trois cas de sporotrichose dermohypodermique, dont un avec lésions du pharynx, du larynx et du tibia, *Bull. Mém. Soc. Méd. Hôp. Paris* 27: 537-546.

Tour, Olga. 1912. Étude des formes du Sporotrichum Beurmanni dans le sang et les séreuses, *Thèse Fac. Méd. Univ. Paris* 424: 1-48, *1 pl.*

Trimble, W. K. & F. W. Shaw. 1909. A case of sporotrichal infection, *Jour. Kansas Med. Soc.* 9: 305-311, *7 figs.*

Troisier, Jean & Albert Berthelot. 1911. Sporotrichose gommeuse lymphangitique et osteoarticulaire guérie par la di-iodotyrosine, *C. R. Soc. Biol.* 71: 264-266.

Umber. 1920. Zur Differenzialdiagnose der Sporotrichose, *München. Med. Woch.* 67: 617, 618.

Vignolo-Lutati, Carlo. 1911. Sopra un caso di sporotricosi, *Giorn. Ital. Mal. Ven. Pelle* 52: 23-31.

Vuillemin, Paul. 1910. Les conidiosporés, *Bull. Soc. Sci. Nancy* III, 11: 129-172.

—. 1911. Les aleurospores, *Bull. Soc. Sci. Nancy* III, 12: 151-175.

—. 1921. Un nouveau champignon parasite de l'homme, Glenospora gandavensis, *C. R. Acad. Sci.* 173: 378-380.

Walker, Norman & James Ritchie. 1911. Remarks on a case of sporotrichosis, *British Med. Jour.* 2: 1-5, *Pl. 1.*

Warfield, Louis M. 1922. Report of a case of disseminated gummatous sporotrichosis with lung metastasis, *Amer. Jour. Med. Sci.* 164: 72-82.

*Watson, E. A. 1920. A note on equine sporotrichosis, *Canadian Vet. Rec.*

Widal, F. & P. Abrami. 1908. Séro-diagnostic de la sporotrichose par la sporoagglutination. La coagulation mycosique et son application au diagnostic de l'actinomycose. La réaction de fixation, *Bull. Mém. Soc. Méd. Hôp. Paris* 25: 947-952.

Widal, F., P. Abrami, E. Joltrain, Et. Brissaud & A. Weill. 1910. Séro-diagnostic mycosique, applications et cofixations mycosiques, *Ann. Inst. Pasteur* 24: 1-33.

*Wohl, Michael, G. 1920. Report of a case of Sporotrichosis, *Nebraska State Med. Jour.* 5: 355.

—. 1923. Fungous diseases of man in the state of Nebraska. Sporotrichosis, blastomycosis, actinomycosis, *Trans. Sect. Path. Physiol. Am. Med. Assn.* 74: 26-45, *10 figs.* [condensed *Jour. Am. Med. Assn.* 81: 647-653, *10 figs.*].

Wolbach, Simeon Burt, W. R. Sisson & F. C. Meier. 1917. A new pathogenic Sporotrichum found in a case of acute arthritis of the knee following injury (Sporotrichum Councilmani), *Jour. Med. Res.* 36: 327-355, *4 pls.*

CHAPTER XXII

MISCELLANEOUS FUNGI IMPERFECTI

CHALAREAE

Mycelium well developed, conidiophores differentiated, dark colored; conidia developing from phialides either solitary or in chains, hyaline or nearly so (Fig. 124).

Key to Genera

Conidia in simple chains or solitary.	
Conidia solitary at tips of phialides, black.	*Conioscypha.*
Conidia in chains, hyaline.	*Chalara.*

CHALARA

Chalara Corda, Icones Fung. **2**: 9, 1838.

The type species is *Chalara fusidioides* Corda.

Mycelium scanty; conidiophores erect, unbranched, straight, dark colored, phialides occurring singly or collected in groups. Conidial chains developing in the necks of the phialides as in the Aspergillaceae, cylindric, elongate, ends not rounding up, hyaline (Fig. 125).

This genus has not been studied from a morphologic point of view, as it is a rare saprophyte. Only a single species has been reported pathogenic.

Chalara pyogenes Roger, Sartory & Ménard, Presse Méd. **22**: 141-143, *2 figs.,* 1914 [1st case C. R. Soc. Biol. **73**: 5-7, 1912].

Found in subcutaneous gummatous nodules which were hard, painless at first, then skin red and painful to pressure. Lesions opened spontaneously, the fistula exuding yellowish liquid. (First diagnosis sporotrichosis.) Cured with KI. Pathogenic to guinea pigs, slightly so to rabbit.

Mycelium 1.5-2μ in diameter, irregular, monopodially branching, forming arthrospores (oidia), cylindric, 2 × 4-5μ, or fusiform, 2.5-3 × 12-13μ. Chlamydospores 13-14μ × 4-5μ, conidia in short chains united by small isthmi, truncated rods. Optimum temperature 28°-30° C.

Isolated only on broth agar, Martin's broth, and ordinary broth. No growth on sugar media. Colonies small, smooth, rosy, shining, little adherent in 10 days; in 15 days spreading in semicircles, margin thus festooned. In 28 days, mammillate, adherent, brown, and in 40 days becomes chocolate colored. Gelatin growth very slow, liquefied in little cups under colonies, color changed. (Klincksieck & Vallette *Code de Couleurs* 78A, 20 days 69E, 28 days 78C, 35 days 78D, translucent 116CD.) In Martin's broth, deposit mucous, forming ribbons on shaking.

CEPHALOSPORIEAE

Cephalosporieae Saccardo, Syll. Fung. 4: 47, 1886.

Conidiophores simple or little branched, either swollen at the tips and bearing conidia on short sterigmata or not swollen and bearing spores in a group held together by a gel.

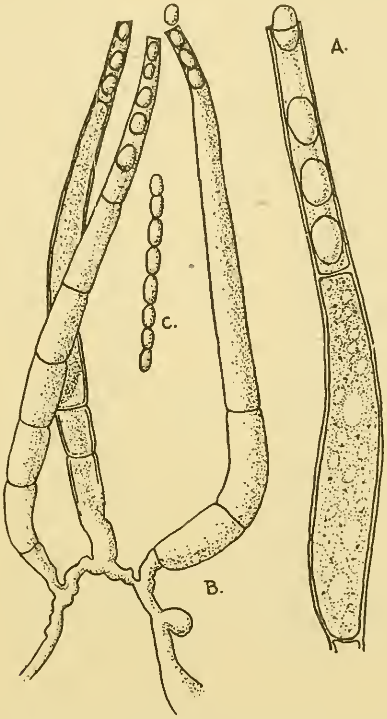

Fig. 124.—*Thielaviopsis paradoxa. A,* phialides; *C,* chain of conida. (After Seynes 1886.)

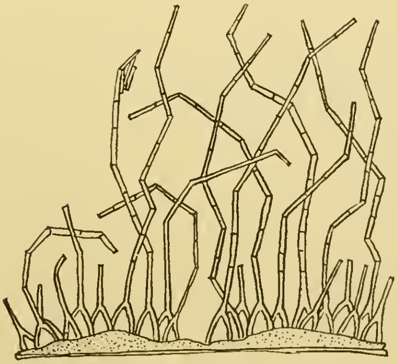

Fig. 125.—*Chalara fusidioides* Corda. (After Corda 1838.)

Many of the genera of this tribe are rather poorly known. In at least one case, a perfect stage has been found for *Cephalosporium* in the Aspergillaceae. The species are mostly saprophytes and should be regarded with suspicion until their pathogenicity is fully proved.

Key to Genera

- Conidiophore unbranched, swollen at the tip.
  - Vesicle with hexagonal reticulations. *Rhopalomyces.*
  - Vesicle without reticulations. *Oedocephalum.*
- Conidiophore unbranched, without swollen tip.
  - Conidial head more or less spherical.
    - Conidia apparently produced simultaneously in a given head, radiating from the head.
      - Conidia spherical or ovoid. *Haplotrichum.*
      - Conidia cylindric. *Cylindrocephalum.*
    - Conidia produced seriatim but clinging together in a ball.
      - Conidia embedded in a gel. *Hyalopus.*
      - Conidia not, or only slightly, embedded in a gel. *Cephalosporium.*
  - Conidial head elongate. *Doratomyces.*
- Conidiophore branched in whorls.
  - Each member of verticil forked and bearing head of conidia on tip. *Spicularia.*
  - Each member of the whorl bearing conidia on upper side on small sterigmata. *Coemansiella.*
- Conidiophore variously branched, not in whorls.
  - Tips of branches acuminate, forming a head on each tip. *Trichoderma.*
  - Tips of branches bearing three or more slender stripes, each bearing a head of spores. *Botryosporium.*
  - Tips of branches swollen bearing radiating sterigmata, each bearing a single spore. *Corethropsis.*

Of the above genera commonly appearing as contaminants (*Cephalosporium, Trichoderma,* and *Corethropsis*), all but *Trichoderma* have also been reported as pathogens. Many of the genera are quite rare.

HYALOPUS

Hyalopus Corda, Icones Fung. **2**: 16, 1838.

The type is not stated by Corda. In this volume he described *H. ochraceus, H. filiformis, H. crystallinus, H. muscorum* (Fig. 126), *H. mycophilus,* and *H. melanocephalus.* All these species he had described and figured in volume I, under the genus *Stilbum.*

Hyphae scanty, repent; conidiophores erect, mostly not septate, not or only very slightly swollen at the tips. Conidia sessile, hyaline or bright colored, clinging together in a gelatinous mass.

This genus is doubtfully distinct from *Cephalosporium.* Most of the species so far described are saprophytes on decaying wood and leaves. Two pathogenic species have been described from the Ivory Coast.

Hyalopus anoma Boucher, Bull. Soc. Path. Exot. **11**: 332-336, 1918.

Isolated from old lesions in three different patients, Ivory Coast. Medication with KI effected a cure. Fatal when inoculated into guinea pigs and rats. Organism recovered.

Hyphae septate, 1-4.5μ in diameter, not moniliform. Conidiophores lateral, septate, 7.5 × 54-75μ with tufts of spores agglutinated by a mucilage. Spores thick-walled, 5μ in diameter, about thirty in a group, the whole resembling a cauliflower on its stalk.

On glucose agar, growth at first white and dry, later turning grayish rose and developing a powdery white efflorescence. Giant colony, grown on glucose, shows at first a central yellowish ray surrounded by white hyphae and bordered by a circle of radiating, hyaline hyphae. The median ray eventually disappears, the colony becomes gray or rose gray in color, the color deepening and becoming accentuated in time with the filaments growing up the glass. On "poor" Sabouraud agar, colonies small and yellowish, later becoming dry and pale with filaments climbing up the glass. On potato glycerol, colonies deep yellow, later becoming deep orange, covering the medium with a loose, silky velvet, afterward becoming granular, and then covered with a white powder. On sweet potato, there forms a loose white velvet, which later becomes a thin gray membrane, spotted with points of yellow or rose red or dark green, eventually long, slender, loose filaments climb up onto the glass. A greenish pellicle forms on the water of condensation and culture and is finally green, covered with white filaments up to 2 cm. long. In glucose broth, a slight cloudiness develops, then gelatinous flocci filling the liquid which becomes viscous with a hyaline veil at the surface. This pellicle finally becomes dotted with white.

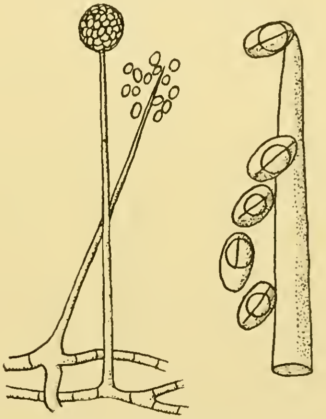

Fig. 126.—*Hyalopus muscorum* Corda. (After Corda 1837.)

Hyalopus onychophilus (Vuillemin) Aschieri, Atti. Ist. Bot., R. Univ. Pavia IV, **3**: 45-63, *8 figs.*, 1932.

Allantospora onychophila Vuillemin, Champ. Paras. Mycoses Homme 63, *Fig. 32,* 1931.

Isolated from a case of onychomycosis in Rome by Tarentelli. Pathogenic to rats.

Sterile hyphae hyaline, septate, about 4.5μ in diameter; fertile hyphae more slender 1.5-2.5μ in diameter, simple or branched; conidia in heads, oblong or ovoid, often curved, 4-18μ long, very rarely septate, hyaline; chlamydospores intercalary, often in chains of 2-3 cells.

On Sabouraud and on Pollacci agar at 25° C. colonies with floccose center and zones of alternating light and dark chestnut. On leather, colony thin, white, becoming clear chestnut. On hair, colony thin, white. On feathers, colonies small white, more or less discrete. On blood agar and coagulated serum, colony thick and yellow. On potato and carrot, colony spreading, white, powdery, the pellicle over the liquid becoming rose color on the carrot. On Raulin liquid, milk and glucose broth, pellicle thick, gelatinous, white, becoming chestnut spotted or finally chestnut. No fermentation, milk coagulated. Optimum temperature about 25°, maximum about 35° C.

CEPHALOSPORIUM

Cephalosporium Corda, Icon. Fung. **3**: 11, 1839.

The type species is *Cephalosporium Acremonium* Corda (Fig. 127).

Hyphae repent, conidiophores unbranched, developing as short lateral branches, erect, not swollen at the tips. Conidia arising singly at the tips, being pushed aside by the following conidium and clinging together by a thin layer of gel on the conidial wall, until a more or less spherical mass of conidia is formed.

It seems quite likely that the mechanism of conidial formation in this group is very close to that of *Aspergillus* and *Penicillium,* but the conidiophore is not swollen or flask-shaped, and if the spores are essentially in chains, they slip past each other so soon that they form spore balls, as in *Gliocladium.* This group is in need of intensive study to clarify its position.

Several species have been reported as pathogenic, but the group is mostly saprophytic and reports should be scrutinized with extreme care to see that pathogenicity is proved. They are very frequently found as contaminants in laboratory cultures.

Key to Species

- Conidiophore simple.
  - Conidia elongate (3 or more times as long as broad).
    - Conidia 4 × 1μ, colony white, becoming rose color; saprophyte. *C. Acremonium.*
    - Conidia 6 × 2μ, colony with brown center and white margin. *C. Doukourei.*
    - Conidia 24.3 × 5.4μ, colony grayish. *C. griseum.*
  - Conidia ovoid, not more than twice as long as broad.
    - Colony white, then rose color, conidia 3-5 × 1.5-2.5μ; gelatin probably not liquefied. *C. pseudofermentum.*
    - Colony grayish, sometimes becoming greenish ochraceous.
      - Conidia 3 × 1.5μ; gelatin not liquefied. *C. kiliense.*
      - Conidia 10-12 × 5-6μ. *C. Boydii.*
    - Colony remaining white, conidia 5.2 × 2.6μ, gelatin liquefied. *C. niveolanosum.*

Colony red brown.	
Conidia 2 × 2.5μ, gelatin liquefied.	*C. rubrobrunneum.*
Conidia 4-5.5 × 2.5-3μ, gelatin liquefied.	*C. Stuehmeri.*
Conidia 4.9 × 3.2μ, gelatin not liquefied.	*C. spinosum.*
Conidiophore branched, branches tapering upward.	
Colony brown.	*C. Serrae.*
Colony white.	*C. Bogolepoffi.*

Cephalosporium Doukourei Boucher, Bull. Soc. Path. Exot. **11**: 328-331, 1918.

Isolated from extensive gummatous lesions on the face of a woman whose whole nose had already been destroyed, Ivory Coast. Fatal to pigeon, mildly pathogenic to guinea pig and rat, the organism being recovered from the lesions.

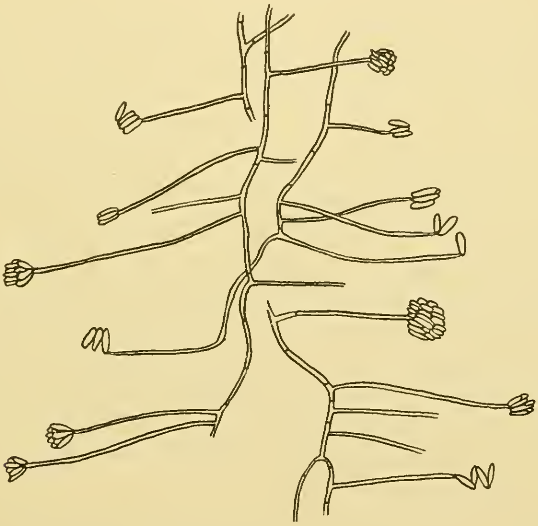

Fig. 127.—*Cephalosporium Acremonium* Corda (×600). (After Lindau 1907.)

Mycelium septate, branching at right angles, occasionally two branches coming from the same cell. Conidiophores erect, 30μ long, terminated by two or three elongate, ovoid spores, recalling *Sporotrichum Beurmanni.* Hyphae moniliform or smooth and united into a coremium. A layer of clear mucilage surrounds the groups of spores. Spores elongate, ovoid at first, becoming biscuit-shaped, 6 × 2μ, with a thick, nonstaining membrane. Gram-positive.

Colony on glucose has a wrinkled white center and radiating hyaline margin when young, becoming rose gray; then the color of barley sugar and a creamy consistency. On Sabouraud conservation agar, colony at first white and dry, becoming wrinkled and creamy. On ascitic agar, tiny white colonies at first, becoming wrinkled and rounded with center brown, margin white and radiately striate. On potato glycerol, colonies very small and slightly yellowish, then grayish with white rays, then orange red covered with a loose white velvet. On sweet potato, growth white, filamentous, becoming thicker and velvety with the substrate slightly browned; finally brick red with a new layer forming which in turn becomes brick red. In glucose broth, liquid at first cloudy, becoming clear with large flakes of hyphae clinging to the glass, a gelatinous ring forming at the surface and becoming yellowish.

Cephalosporium griseum Gougerot, Burnier & Duchè, Bull. Soc. Franç. Derm. Syphiligr. **40**: 417, 418, 1933.

Isolated from an ulcer on the leg following puncture by piece of rusty iron, abscess and ulcer formed, 4 × 2 cm., infiltrated, thick, margins elevated, violet, surface rugose, verrucose. Wassermann negative. Lesion healed after treatment with 6 gm. potassium iodide internally per day and local applications of tincture of iodine after 25 days.

Hyphae 3μ in diameter, conidia elongate or ovoid, $24.3 \times 5.4\mu$, agglomerated into heads.

On Sabouraud glucose agar at 25° C., colony forms grayish tufts.

Cephalosporium pseudofermentum Ciferri, Arch. Protistenk. **78**: 227-237, *1 pl.,* 1932.

Isolated from an atypical case of gingivitis accompanied by intestinal disturbance, Santo Domingo. Cultures lost in the hurricane of 1930 before the study of cultural characters or pathogenicity was completed.

Mycelium repent, slender, septate at branches, $1.5\text{-}2.5\mu$ in diameter, that developing within the substrate more irregular, $2\text{-}6\mu$ in diameter; intercalary chlamydospores present and budding off occasional sprout cells which may sprout further by unipolar budding. These pseudoyeast cells never form giant cells, aggregations of cells, etc., as in the yeasts, and germinate directly to hyphae. Probably they are only a temporary condition produced by unfavorable conditions for normal development, such as occurs in widely different groups. Conidiophores $20\text{-}50\mu$ tall; conidial heads $5\text{-}45\mu$, mostly $10\text{-}20\mu$ in diameter; conidia $1.5\text{-}2.5 \times 3\text{-}5\mu$.

Colonies at first suggesting those of a pink yeast, soon showing a margin of fine filaments, pale rose, old rose, or carmine. In liquid media, producing a pellicle, at first arachnoid then with rose colored islets; little sediment of yeastlike cells, dirty yellow; conidial heads rare on liquid media.

Cephalosporium kiliense (Gruetz) Hartmann, Derm. Woch. **82**: 569, 1926.*

Acremonium kiliense Gruetz, Derm. Woch. **80**: 765-774, 1925.

Cephalosporium asteroides griseum Gruetzii Benedek, Arch. Derm. Syphilis **154**: 166, 1928.†

Cephalosporium Acremonium Pollacci & Nannizzi, I Miceti Pat. Uomo Anim. **9**: No. 81, 1930; Pittotti, Riforma Med. **48**: 1567, 1568, 1932; non Corda, 1839, which is a saprophyte. Cf. Benedek, Derm. Woch. **88**: 892-897, 1929.

---

*Hartmann nowhere uses this combination, but he actually shows that *Acremonium kiliense* Gruetz belongs in *Cephalosporium*. Apparently the lack of the formal combination was an oversight.

†Benedek describes the species in Latin in order to rename it, thinking that a description in the vernacular was invalid by the International Rules of Nomenclature, but he overlooked the fact that only binomial names are valid; and by his use of a polynomial, his proposed name was also invalid. The International Congress at Cambridge 1930 validated all names of species described in vulgar languages from 1908 to 1932.

Isolated from gummata and ulcers in man.

Hyphae repent, 1-1.5μ in diameter, branched, cells 11.4-15.2μ long, hyaline; conidiophores simple, one-celled, 20-60 × 1.3-1.5μ; conidia in terminal spherical heads, 7.6-16.2μ in diameter, hyaline; conidia ovoid hyaline, 3.0 × 1.5μ.

On Gruetz agar (8% glucose), colony flat, gray white, becoming 5-6 cm. in 6 weeks, gray to dark gray with smooth moist folds. Similar on potato and carrot. Dark brown pigment diffusing on maltose broth. Litmus milk reduced, gelatin not liquefied; acid produced in glucose, fructose, dextrin, and inulin. Optimum temperature 18°-20°, no growth at 37° C.

Cephalosporium Boydii Shear apud Boyd & Crutchfield, Amer. Jour. Trop. Med. **1**: 258-268, 1921; *Mycologia* **14**: 242, 1922.

Imperfect stage of *Allescheria Boydii* Shear (see p. 652).

Cephalosporium niveolanosum Benedek, Arch. Derm. Syphilis **154**: 166, 1928.

Isolated from a case of dermatitis in Leipzig.

Hyphae repent, 1.0-1.5μ in diameter, branched, cells 20-30μ long, hyaline; conidiophores erect, simple, 30-70 × 1.0-1.3μ; heads spherical, 5.2-15.2μ in diameter, hyaline; conidia ovoid, 5.2 × 2.6μ.

On 8% glucose agar, potato, and carrot, colony snow white, woolly with coremia which become 10-12 mm. high; good growth on liquid media, litmus milk reduced, gelatin liquefied; acid on starch only. No growth at 37°, optimum temperature 18°-20° C.

Cephalosporium rubrobrunneum Nannizzi, Tratt. Micopat. Umana [Pollacci] **4**: 455, 1934.

Cephalosporium rubrobrunneum cerebriforme Hartmanni Benedek, Arch. Derm. Syphilis **154**: 166, 1928.

Cephalosporium kiliense Hartmann (pro parte), Derm. Woch. **82**: 565, 1926 (see footnote, p. 828).

Acremonium sp. Ballagi, Arch. Derm. Syphilis **166**: 405-407, *2 figs.*, 1932.

Isolated from a case of dermatitis in Frankfurt a.M., Germany. Probably the case of Lehner (1932) studied by Ballagi (1932) belongs here.

Hyphae repent, 1.5-2μ in diameter, branched, cells 20-25μ; conidiophores erect, unicellular or septate at the base, simple, 30-60 × 1.3-1.5μ; conidia in heads 5.2-15.6μ in diameter; conidia spherical or short ovoid, 3 × 2μ.

Colonies on 8% glucose, on potato, or on carrot, grayish white with deep radial depressions becoming 4-5 cm. in diameter in 6 weeks, dirty gray with white center, and finally red brown in 2-3 months. Litmus milk reduced, gelatin liquefied, acid on glucose, fructose, galactose, dextrin, and inulin. Optimum temperature 18°-20° C., no growth at 37° C.

Cephalosporium Stuehmeri Schmidt & Beyma in Beyma, Centralbl. Bakt. I, **130**: 102-105, *3 figs.*, 1933.

Isolated from eczematoid infection of the skin, Germany. Pathogenicity for experimental animals not reported.

Hyphae repent, 2-3.3μ in diameter, in old cultures up to 6μ, with large oil droplets, sparingly septate; conidiophores erect, not septate, 30-40μ tall, 2μ thick at the base, tapering upward; conidia in heads, 10-15μ in diameter; conidia ovoid to ellipsoid, 3-6 × 1.7-2.3μ, mostly 3.3 × 2μ.

Colonies on malt agar with radial furrows, cottony, grayish in the center with some small coremia, finally bright reddish brown, reverse reddish yellow (*Code des Couleurs* 178D) and mealy from conidial heads. On Sabouraud agar, colony elevated with central coremia, white to light rose. Gelatin liquefied.

Cephalosporium spinosum Negroni, C. R. Soc. Biol. **113**: 478-480, 1933.

Isolated from a case of onychomycosis (toenails) in Argentina. Nails show yellowish, spongy spots, without paronychia.

In nails, hyphae septate, much branched. In cultures, sterile hyphae repent, 1.5-2μ in diameter, producing coremia; conidiophores 1.3-1.5μ in diameter, 27-30μ tall; conidia in heads, ovoid, 4.9 × 3.26μ, smooth, hyaline.

On Sabouraud honey agar, colony dirty gray and rough from coremia. On Czapek agar, colony plane with about a dozen radial folds and numerous secondary folds; surface very spiny from coremia; zonate with dirty, purplish red color, margin dirty gray; reverse café-au-lait with reddish brown spots. On Raulin's liquid with various carbohydrates, pellicle thick, white with reddish zones. No fermentation, acid produced with glucose, fructose, maltose, sucrose, inulin, and galactose, somewhat in raffinose; lactose becomes alkaline; nitrate reduced to nitrites. Milk not coagulated, gelatin not liquefied.

It is uncertain whether the earlier case described by Negroni should be referred here, although it is also possible that this is a more complete study of the earlier case. One is greatly puzzled by the report of large septate spores (suggesting *Fusarium* or closterospores of *Epidermophyton* in the earlier paper). Is it possible that the septate spore belonged to the species of *Epidermophyton* causing the intertrigo of the toes?

Cephalosporium sp. Negroni, Rev. Univ. Buenos Aires II, **29**: 350-355, *Figs. 53-56,* 1931.

Found in intertrigo of the toes and onychomycosis, in Argentina. [For case history see Rev. Soc. Argentina Derm. Sifilol. 1929 or 1930.] Not pathogenic for rabbit.

In nails and scrapings, flexuous hyphae with branched conidiophores and reniform spores. From cultures, vegetative hyphae, 3-4μ in diameter, grouped in funiculi, hyaline, septate, vacuolate, with fat globules. Conidiophores hyaline, smooth, septate, 3μ in diameter, tapering upward, 40-65μ tall, verticillately branched. Spores in a head at the tip, held together by a gel, 5-8 × 3-5μ. Other fusiform spores 40 × 6μ, 1-4-celled, also seen in preparations.

Colony on Czapek agar, velvety, dirty white with concentric zones; reverse slightly yellowed or not colored.

Cephalosporium Bogolepoffi (Vuillemin) Dodge, n. comb.

Tilachlidium Bogolepoffi Vuillemin, Bull. Soc. Myc. France **28**: 113-120, *Pl. 6,* 1912.

Mycoderma Bogolepoffi Jannin, Les Mycoderma 188-190, 1913.

Geotrichum Bogolepoffi Basgal, Contr. Estudo Blastomicoses Pulmonares 48, 1931.

Isolated from the sputum of a patient in a hospital at Tomsk, Siberia, by Bogolepov. Further case history and pathogenicity unknown to me.

Hyphae repent, conidiophores erect, fasciculate, much branched, septate at the base, 40-50μ tall, 2-3μ in diameter at the base, tapering to 0.5μ at the tip; conidia in heads 7-18μ in diameter; conidia elongate ellipsoid, 3.5-6.5 × 1.1-1.2μ when first cut off, expanding to 5-7 × 2-2.5μ when fully mature. In young cultures single conidia may be cut off on the repent hyphae.

Culture white, developing on carrot or nutritive gelatin either at 20° or 35° C. When growth is vigorous, the surface is covered with pointed coremia, 1-3 mm. long.

This organism is somewhat problematical as it has not been reported since its original isolation. Since it was studied considerably later in France, it is possible that we have here a contaminant, or occasional organism from the air, accidentally in the sputum. It is also possible that this and the following organism should be placed in *Gliocladium* on account of the branched conidiophores.

Cephalosporium Serrae Maffei, Atti Ist. Bot. R. Univ. Pavia IV, **1**: 183-198, *9 figs.*, 1930.

Cephalosporium sp. Serra, L'Ateneo Parmense **1**: 549-580, *8 pls.*, 1929.

Found in keratomycosis of the eye. Pathogenic to laboratory animals.

Hyphae branched, decumbent, sparse, hyaline, slender, very little septate, granulose, 2.5-5μ; conidiophores not very long, 2.3-4.6μ at the base tapering to 1.5-2μ in diameter at the apex. Conidia in heads 8-20μ in diameter, quickly separating, hyaline, 2-10 × 2-4-5μ or 4-7.5 × 2μ depending on age and beginning of germination, ellipsoid, spherical, ovoid, oblong-ovoid or pyriform, sometimes slightly constricted in the middle or septate, granulose; guttulate; chlamydospores solitary or in chains, at first hyaline, then brown, almost always spherical, 4-7μ; 11-17μ (*sic*) with a thick membrane.

Colony rose color at first, becoming fuscous from the mass of brown chlamydospores; folded irregularly. Gelatin liquefied after 2 weeks.

Differs from other pathogenic species by larger and little septate hyphae, conidiophores branched and thick with the heads easily breaking up and by the size, form, and guttulation of the conidia and the brown chlamydospores. The branched conidiophores suggest that this species may belong rather in *Gliocladium* near *G. roseum* (Link) Bainier.

CORETHROPSIS

Corethropsis Corda, Prachtflora Europ. Schimmelbidungen *Pl. 1*, 1839 [translated as Flore Illus. Mucedineae d' Europe *Pl. 1*, 1840].

The type species is *Corethropsis paradoxa* Corda (Fig. 128).

Hyphae repent, septate; conidiophores short, short simple or 2-3-furcate, erect, slightly swollen at the tip, bearing a head of radiating conidia. Conidia with short sterigmata, ellipsoid, hyaline, unicellular.

In his original description and figure, Corda shows a long coremium with tufts of spores on short branches. Saccardo and others have considered that he had a *Corethropsis* parasitic on an *Isaria* and that the large coremium belonged to the host rather than to the parasite.

It is very doubtful whether Vuillemin has interpreted Corda's figures correctly. *C. hominis* may belong here. *C. Puntonii* almost certainly does not.

Corethropsis hominis Vuillemin apud Spillmann & Jannin, Bull. Soc. Franç. Derm. Syphiligr. **24**: 227, 228, 1913; Rev. Méd. de l'Est, Nancy **45**: 458, 1913.

Isolated from a gummatous lesion on the forearm which healed promptly after 4-5 days' medication with KI.

Spores terminal, single on differentiated branches, round or pyriform, 2×3-$2 \times 2.5\mu$, mycelium composed of fasciculate hyphae, 1-2μ in diameter, with lateral conidiophores terminated by a spore. Sporiferous clusters abundantly branched, producing spherical pulvinate forms.

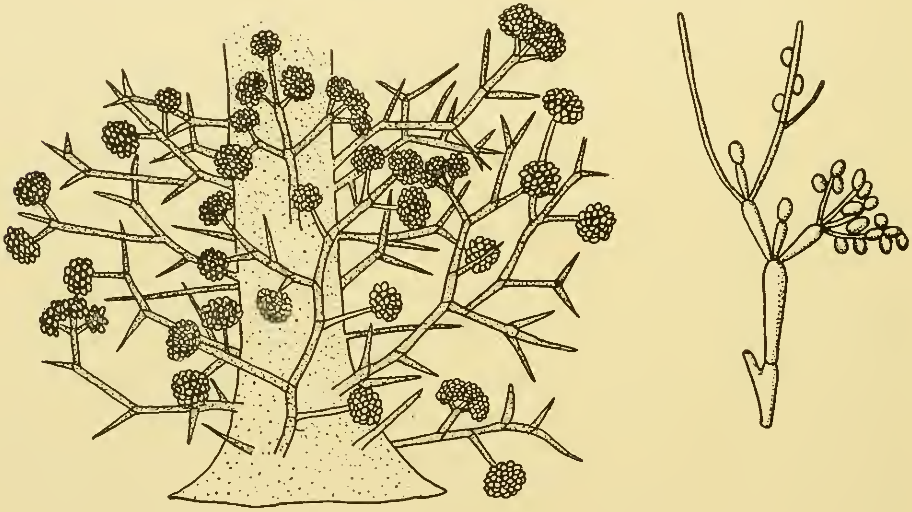

Fig. 128.—*Corethropsis paradoxa* Corda. (After Corda 1839.)

Young cultures grown at 20-30° C., adherent, covered with fine or thick arborizations, 2-4 mm. high, in the form of denticulate phialides, 1-2 mm. broad; white when grown in the dark, yellow when grown in the light. Ten-day-old cultures are pulverulent and grayish or greenish because of the spores.

Corethropsis Puntonii Vuillemin, C. R. Acad. Sci. **190**: 1334, 1335, *1 fig.*, 1930.

Found associated with *Torula Mansoni* in dermatosis in Colombia, comm. Vittorio Puntoni.

The hyphae having chlamydospores without distinctive characters are branched, terminated by aleurospores, truncate at the base with a thick wall, up to 8μ. Sometimes 1 or 2 new aleurospores develop below the terminal one, similar in structure but decreasing in size. More slender branches often produce chains of nearly spherical spores, about 2μ in diameter. Tips of other branches bear groups of swollen flask-shaped cells which, in turn, bear slender chains suggesting phialides, but probably this resemblance is superficial.

PHIALOPHOREAE

Conidia borne on short, rounded phialides, clinging together in a gel, mycelium and conidia dark colored, mouth of the phialide dilated.

At present, only the genus *Phialophora* is known with the characters of the order.

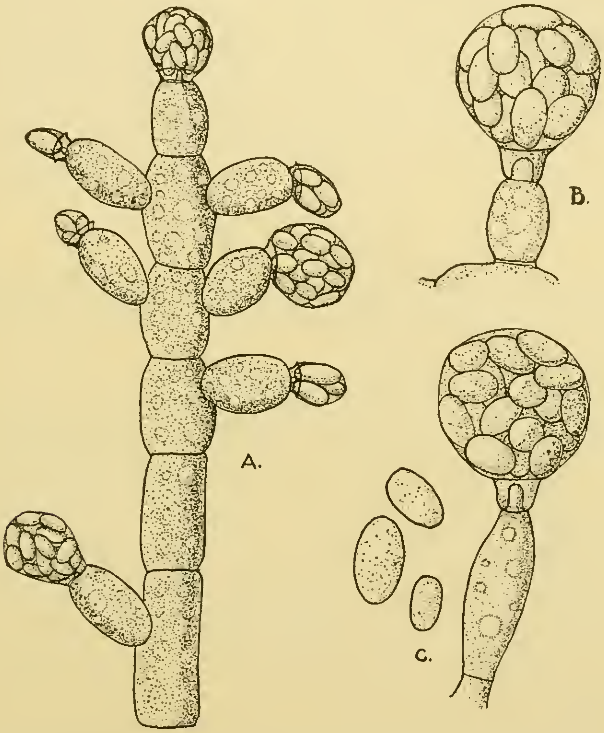

Fig. 129.—*Phialophora verrucosa* Thaxter in Medlar. *A*, habit sketch showing hypha with conidiophores and gelified masses of conidia; *B*, detail of conidiophores; *C*, conidia. (*A*, after Medlar; *B* and *C*, after Thaxter in Medlar 1915.)

Phialophora verrucosa Thaxter in Medlar, Mycologia **7**: 200-203, 1915; Jour. Med. Res. **32**: 507-521, *Pls. 29-33,* 1915.

Isolated from a small tumor in the skin of the buttocks of an Italian in Boston, Massachusetts. Tumor measured 2.5 × 2 cm., was purplish color, elevated 3 mm. above the surface of the skin, soft but not tender, with an irregularly papular surface showing a few grayish scales. From the crater could be expressed a grayish, somewhat cheesy substance, with which was mixed a little blood.

Hyphae composed of cells 4-2.5 × 2-6μ. Sporogenous cells short, ampulliform or more elongate, usually terminal or irregularly distributed near the ends of the ultimate branchlets, the lips of the terminal cups spreading. Spores ovoid to ellipsoid, somewhat variable in form and size, usually about 4-5 × 2-3μ, hyphae 2-6μ in diameter. Conidial formation in tissues and in certain media, such as hydrocele agar, budded out in short chains, 2-6 cells long, or single on short branches. Similar to other spores, but more ovoid (Fig. 129).

On hydrocele agar on the sixth day, grayish black, pinpoint colonies composed of radiating, septate hyphae with brownish wall. In 3 weeks, colony was 4 mm. in diameter, penetrating 1-2 mm. into the medium, very tenacious, round, brownish black. Medium diffusely colored chocolate brown.

Apparently, this species has been found only once (Wilson, Hulsey & Weidman, 1933) since the original case, all other reports in the literature being shown after careful study to be based on entirely different organisms.

GONATOBOTRYTIDEAE

Conidia usually borne in groups on intercalary swollen cells along the vegetative hyphae.

THOMIELLA n.g.

Hyphae repentes, septatae, hyphis conidiophoris erectis vesiculis terminatis; phialidae desunt; conidia catenulata basifuga leniter minora, non aequalia. Gonatorhodiellae affinis.

The type species is *Aspergillus Dessyi* Spegazzini.

Sterile hyphae creeping, septate; conidiophores erect, ending in a swollen vesicle; no phialides present; conidia in short, more or less radiating chains, with the oldest cells of the chains next the vesicle and decreasing in size toward the distal ends of the chains.

This very anomalous genus, which may be related to *Gonatorhodiella,* has a very peculiar formation of spore chains, being the only genus, with which I am familiar, in which the spores vary conspicuously in diameter in the same chain. Evidently, the conidium next the vesicle is the oldest and cuts off, successively, smaller conidia with the smallest and youngest conidia distal to the vesicle. This suggests vaguely some sprouting conditions found in the Eremascaceae Imperfectae. On the other hand, some characters suggest relationship with *Gonatorhodiella,* first pointed out to me in a conversation with the late Dr. Thaxter.

I take great pleasure in dedicating this genus to Dr. Charles Thom, who has devoted a lifetime to the study of the Aspergillaceae and related Fungi Imperfecti. It is to be hoped that some of the active Argentine workers will again discover this interesting genus and give us further knowledge of its morphology.

Thomiella Dessyi (Spegazzini) Dodge, n. comb.

Aspergillus Dessyi Spegazzini, Physis, Rev. Soc. Argentina Cien. Nat. **8**: 115-117, *1 text fig.,* 1925.

Isolated from an Italian patient with a dermatosis in a hospital in Buenos Aires. Pathogenic to rabbits, guinea pigs, and rats, not to hens.

Hyphae 2μ in diameter, hyaline or slightly yellowish. Other hyphae 4-5μ in diameter, straight and darker; nodose hyphae of fusiform cells 15-25 × 5-8μ. Stalks 40-250μ long, only 2-2.5μ in diameter in the lower third, expanding to 5-10μ in diameter. Vesicle 12-20μ in diameter, with a slender annular line at the base, spores arising only from upper two-thirds. Total cross-section of head 35-50μ, greenish lead color. Phialides absent, basal conidia, 4μ in diameter, spherical. Simple radiating chains of 4-6 conidia, diminishing in diameter upward, 3.5-3.75μ in diameter below to 3μ above with thin, smooth wall.

Growth good on usual media between 12° and 37° C., especially good on glucose media. Colonies cottony, white, yellowing in the center, becoming a thick mat about 0.5-1 mm. thick, opaque on reverse with a white yellowing border. Free surface between brown and greenish red, slightly pubescent or occasionally cottony. Old colonies sometimes have an odor of hydrogen sulphide. Gelatin not liquefied.

BOTRYTIDEAE

Conidiophore differentiated, branched, branches not in verticils, bearing solitary hyaline conidia at the tips of the branches.

Key to Genera

- Conidiophores unbranched or slightly branched, or the branching only suggested by knobs.
  - Conidiophores wholly unbranched, conidia either pleurogenous or acrogenous. *Acladium.*
  - Conidiophores branched slightly.
    - Conidia sessile.
      - Conidia ovoid or spherical. *Haplaria.*
      - Conidia short cylindric. *Cylindrotrichum.*
    - Conidia borne on sterigmata, etc.
      - Conidiophores swollen above, conidia on long sterigmata. *Physospora.*
      - Conidiophores not swollen, conidia on short sterigmata. *Phymatotrichum.*
        - Conidia on warts. *Cristularia.*
  - Conidiophores in fascicles, parasitic on plants.
    - Conidia smooth. *Ovularia.*
    - Conidia echinulate. *Ramulaspora.*
- Conidiophores much branched.
  - Conidia spherical or ovoid.
    - Conidiophores dendroid, conidia single, acrogenous. *Monosporium.*
    - Conidiophores with a few long slender branches, conidia on very small sterigmata. *Botrytis.*
    - Conidiophores with many shorter, thicker branches, conidia on large sterigmata. *Polyactis.*
  - Conidia cylindric.
    - Conidia all acrogenous. *Cylindrophora.*
    - Conidia acrogenous on short side branches but the terminal branches sterile. *Cylindrodendrum.*

ACLADIUM

Acladium Link, Mag. Ges. Naturf. Freunde Berlin **3**: 11, 1809.
The type species is *Acladium conspersum* Link (Fig. 130).

In his *Observationes*, Link described *Acladium* as follows: *Thallus e floccis caespitosis erectis, simplicibus aut subramosis, septatis. Sporidia inspersa. Genus varium, floccis erectis caespitosi simplicibus aut subramosis distinguendum. Omnes species caespitulos formant initio parvos rotundos, dein dilatatos ac diffusos. Fortassis is plura genera dividendum.* He treats four species: *A. conspersum, A. herbarum* (*Dermatium herbarum* Pers.), *A. capitatum*, and *A. microspermum*.

In Link's revision of the Fungi of Willdenow's edition of Linné's *Species Plantarum* **6**: 37, 1824, only two of the original species are retained, *A. herbarum* having been transferred to *Cladosporium* and *A. capitatum* to his *Aspergillus roseus*. Hence, either *A. conspersum* or *A. microsperum* must be chosen as the type. Since the former was evidently the best known, it should be taken as the type. Bonorden, Saccardo and Lindau have followed this concept.

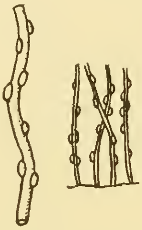

Fig. 130.—*Acladium conspersum* Link. (After Bonorden.)

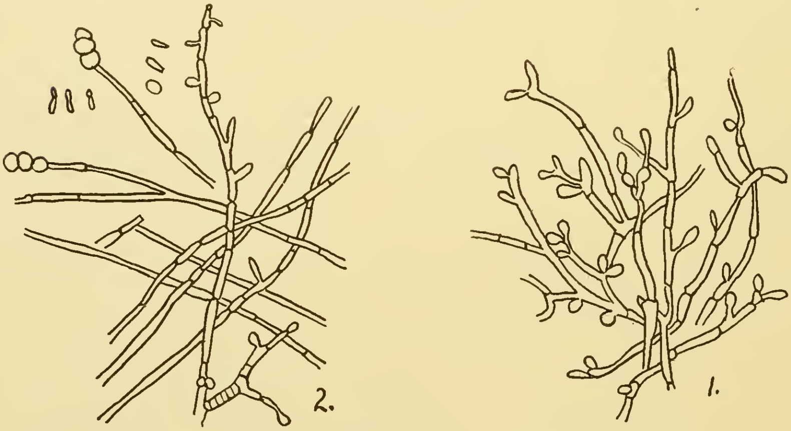

Fig. 131.—*Acladium Castellanii.* (After Castellani 1916.)

Hyphae repent; conidiophores erect, unbranched, septate or not; conidia lateral, sessile, unicellular, or hyaline.

A single pathogenic species has been referred here. It has been so little studied morphologically that its position here is uncertain.

Acladium Castellanii Pinoy apud Castellani, Brit. Med. Jour. **2**: 486, *1 pl.*, 1916.

Pseudomicrosporon Castellanii Craik, Jour. Trop. Med. Hyg. **26**: 184, 185, 1923.

Found in Ceylon, Malay States, and Macedonia in small lesions usually diagnosed as syphilitic. Ulcers sharply defined, roundish or oval, with red granulating fundus. The purulent secretion dries up in thick yellow crusts covering the ulcers. Gummatous nodules and furuncular lesions may also be observed. Little or no pain, pruritus usually absent. Wassermann negative. Mercury and arsenic compounds have no effect. Lesions promptly cured by medication with KI (20 gm. t.i.d.).

Hyphae 2μ in diameter with pseudoconidia of varying shape—cylindric, pyriform, or spherical—attenuate at point of insertion. Pseudoconidia, 4 × 2μ. Occasionally chlamydospores in short chains, spherical, often terminal, 8-10μ in diameter (Fig. 131).

Organism grows on Sabouraud agar, glucose agar, carrot or potato. Colonies on carrot or potato whitish, covered with spiculated formations consisting of straight parallel filaments. On glucose agar, after 4-8 days, colonies small, amber yellow, becoming hemispheric and coalescing into a knotty mass. If colonies do not fuse, they increase and show radiating furrows.

Colonies dimorphic, smooth (mostly below 20° C. in malt agar). Oidia and chlamydospores present; rough, with coremia bearing hyaline, pyriform, sessile conidia, 2 × 3μ—Craik (1923).

MONOSPORIUM

Monosporium Bonorden, Handb. allg. Mykol. 95, 1851.

The type species is *Monosporium agaricinum* Bonorden.

Bonorden described his genus very briefly as possessing branched hyphae bearing round or ovoid spores on the tips of the branches, the branches not regularly divided. He treats 15 species and mentions 2 others. *M. corticola, M. agaricinum, M. spinosum* (Fig. 132), *M. membranaceum, M. decumbens, M. viridescens, M. reflexum*, and *M. acuminatum* are described as new, most of the others evidently known to the author only from figures. The figures of *M. acuminatum, M. spinosum, M. agaricinum,* and *M. membranaceum* resemble each other much more closely than they do the other members of Bonorden's genus. Within this group, the choice of type species is arbitrary.

Hyphae repent, septate, branched; conidiophores erect; septate or not, more or less dendroid, branched, branching often dichotomous; branches usually tapering to a point, bearing a single hyaline, smooth, unicellular, thin-walled, ovoid conidium.

In the pathogenic species, the conidiophores are somewhat decumbent and are said to have been transferred by Saccardo to a new genus, *Scedosporium*, but I have been unable to find where this name was validly published. Saccardo did not recognize this name in later volumes of his *Sylloge Fungorum*. All of the pathogenic species so far reported have produced black grained mycetoma pedis.

Monosporium apiospermum Saccardo, Ann. Myc. **9**: 254, 1911; Radaeli, Giorn. Ital. Mal. Ven. Pelle **52**: 109-116, *1* pl., 1911.

Scedosporium apiospermum Saccardo, 1914.

Aleurisma apiospermum Maire apud Montpellier & Gouillon, Bull. Soc. Path. Exot. **14**: 285-290, 1921.

Indiella americana Delamare & Gatti, C. R. Acad. Sci. April, 1929; fide Peña, Rev. Med. Cirurg. Brasil **38**: 142-147, *1 fig.*, 1930, who studied their culture.

Isolated from cutaneous granuloma of the human foot, North America, Brazil, and Europe.

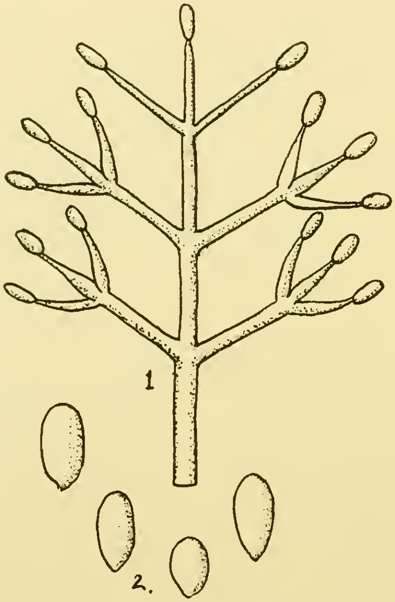

Fig. 132.—*Monosporium spinosum* Bonorden. (After Saccardo.)

Hyphae white, then slightly fuscous, cottony; conidiophores not erect; vaguely and sparingly branched, sparingly septate, 2.5-3μ, branches ascending, slightly attenuate, terminated by a single conidium each; conidia unicellular, pyriform, oblong or obovoid, truncate at base, 11 × 5.6-5.7μ, rarely almost spherical, guttulate, smooth, hyaline at first becoming light dirty rose yellow. Sclerotia abundant in tissues of host and on certain culture media (Fig. 133).

Colonies on Sabouraud agar after 5 days, of lentil size, raised, covered with a white velvet, surrounded on the eighth day by a circular furrow, center finally pale chamois in color with remainder a brown yellow. On potato growth same as above, but more luxuriant, substrate blackening on fifth day. On carrot the same, carrot blackening in 10 days. Growth on corn, barley, or oats white, cottony, becoming mouse gray and arachnoid. Similar growth on bread crumbs, but deeper part greenish. Same, but less luxuriant, on beans or onions. In hay infusion (20%), slightly acid, hemispheric growth at bottom of tube on fifth day. Same in Sabouraud maltose broth, peptone glucose broth, potato decoction, or carrot decoction.

Interesting cases have been reported by Montpellier (1921, 1924), Linhares (1917), Magalhães (1919), Fonseca & Arêa Leão (1927), and Gay & Bigelow (1930). Unpublished observations of R. F. Smart in my laboratory indicate suggestions of copulation and sexuality but, unfortunately, Smart's studies were interrupted before completion. Sclerotia were very abundant in corn meal agar.

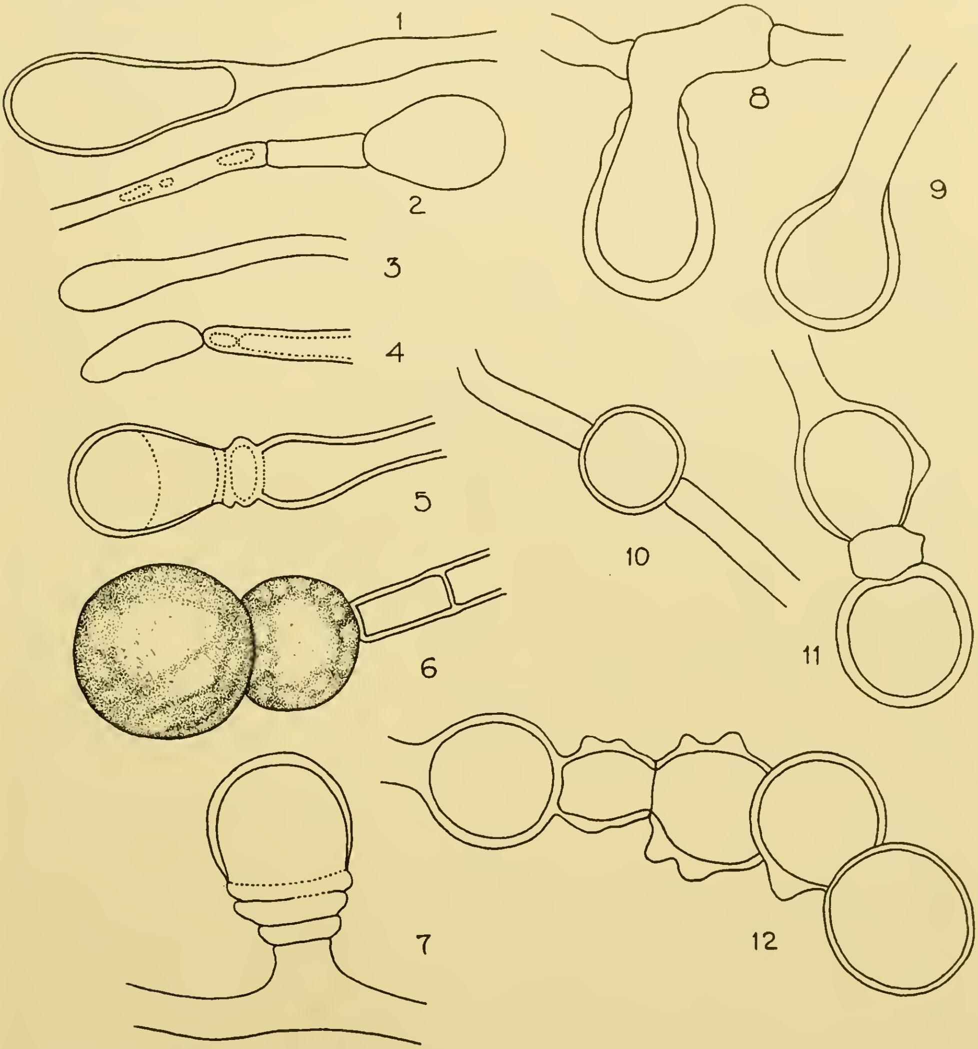

Fig. 133.—*Monosporium apiospermum* Saccardo. *1, 2,* pyriform conidia; *3, 4,* crescent or fusiform conidia; *5-12,* chlamydospores in various stages of development. (After Fonseca & Arêa Leão 1927.)

Var. **Peperei** Sartory, Champ. Paras. Homme Anim. 681, 682, 1922.

Monosporium sclerotiale Pepere, A. Soc. fr i Cultori di Sci. Med. e Naturali i Cagliari 18 juin 1914; Sperimentale **68**: 543, 1914.

Scedosporium sclerotiale Brumpt, Précis Parasitol. 1114, 1922.

Isolated from a black grain mycetoma, grains 1-2 mm. in diameter. Pathogenic to laboratory animals.

Hyphae slightly brownish, rarely septate, 3-4μ, some 5-5.5μ, branched, sometimes united into strands. Conidiophores slender and short, erect or decumbent, bearing a single terminal conidium, 10-14 × 4-7μ, sometimes [younger?], spherical or ovoid and smaller, 5-7μ, point of insertion yellowish; conidia with oil globules and opaque brown granules. Very rarely in old cultures, 2-3 spores appear at the end of a single conidiophore. Sclerotia common in old cultures. Growth under anaerobic conditions very slow. In very old drying out cultures, anaerobic cultures and colonies in collodion sacs in the peritoneum or under the skin of rabbit or guinea pig, sclerotioid growths are produced. Hyphal cells swollen somewhat irregular, contorted, having a pseudoparenchyma without and more normal hyphae within; conidiophores abnormal, spores nearly round. Also coremia present at the periphery of the colony.

On simple agar, colonies develop slowly, transparent, then white, slightly elevated, confluent. On Sabouraud agar, growth good on either glucose or maltose, colony round, center hemispheric, translucent or glassy, finally covered with hyphae. Central elevation becomes irregular, mammillate, surrounded by a ridge, giving a somewhat crateriform appearance and ridge surrounded by a furrow, not blackening. On potato or potato glycerol, small white colonies with rapid growth, hemispheric with long cottony hyphae, in 6-7 days surface covered with a gray or gray brown coating with tendency to greenish or black. Old colonies completely convoluted, losing their cottony appearance. On beets, colonies white, much the appearance of potato. On banana, growth slow, colonies umbilicate, remaining white, although in old cultures brown guttation may appear. On gelatin, development not very good at 20° C.; liquefaction slow and scarce. On serum or serum glycerol, colonies oval, central portion mammillate, hemispheric, translucent, glassy. In broth, with glycerol or glucose, colonies translucent, yellowish white, opaque, adherent, confluent, folded, then brownish; filaments from the margin climb the walls of the tube. On hay infusion + agar 2%, development rapid, colonies round, convex, with rapid formation of hyphae. On hay infusion, colonies spherical, mucilaginous, center dark, finally producing a white pulverulent pellicle which easily breaks up and falls to the bottom. On potato decoction, about the same. In beef broth, development slow, small colonies yellowish, tending to brown, surface granular, finely mammillate, adherent to the tube, with aerial colonies convex, white, or grayish white. In old cultures (30-35 days), colonies form a long, blackish cylinder, finally reaching the bottom of the tube, broth clear. Presence of sugars does not modify development. On peptone water, development slow, small white colonies adherent to the walls and finally making a thin white pellicle.

Monosporium Magalhaesi (Fróes) Dodge, n. comb.

Scedosporium Magalhaesi Fróes, Do Mycetoma Pedis no Brazil 49, 1930 [name only].

Scedosporium sp. P. S. Magalhães, Hyphomycetoma Nova Mycose. Rio de Janeiro, 1919.

Monosporium tulanense (Castellani) Agostini, Jour. Trop. Med. Hyg. **35**: 266-269, *3 figs.*, 1932.

Blastomycoides tulanensis Castellani, Amer. Med. **32**: 292, 1928; Amer. Jour. Trop. Med. **8**: 386, 387, 1928.

Aleurisma tulanense Ota & Kawatsure, Arch. Derm. Syphilis **169**: 156-160, 1933.

Isolated by Castellani from "blastomycosis" in Louisiana, organism studied by Agostini (1932). Pathogenicity unknown.

Hyphae 1-2μ in diameter, branching, often in fascicles; conidial mycelium 4-5μ in diameter; conidia pyriform, 5-7 × 3-5μ; arthrospores present; chlamydospores 8-15μ, thick-walled, often with fat globules [mistaken by Castellani for ascospores]; found both on media and in host tissues.

On Pollacci agar, colonies white, adherent, slightly fluffy. No growth on blood agar. In liquid media, colonies coalescing into a mucilaginous mass. Milk not coagulated, gelatin and serum not liquefied at first but later some liquefaction takes place. No fermentation of any carbohydrates.

var. **mannitolfermentans** Castellani, Jour. Trop. Med. Hyg. **36**: 306, 1933. Differs from the species producing acidity in mannitol but not in other carbohydrates.

Monosporium venezuelense Castellani, Jour. Trop. Med. Hyg. **36**: 307, 1933.

Isolated from a case of blastomycosis in Venezuela and from one in Central America.

Conidia ovoid, 7 × 4-4.4μ; sterigmata up to 10.5μ.

Colonies becoming dark brown or even black on glucose agar. Gelatin rapidly liquefied.

VERTICILLIEAE

Mycelium hyaline or light colored, conidiophores differentiated, branched, conidia borne in verticils.

Key to Genera

Conidiophores sterile on ends of main branches, conidia borne singly on short flask-shaped side branches. *Pachybasium.*
Conidiophores not sterile on ends of main branches.
  Conidia and branches not surrounded by a gel, borne singly.
    Conidia spherical, ellipsoid, ovoid, clavate, neither cylindric nor elongate.
      Conidia single on tips of branches, soon falling, not clavate. *Verticillium.*
      Conidia clavate, single, terminal, fertile branches ending in two clavate cells, which are perpendicular to each other. *Verticilliopsis.*
      Conidia 3-4 in a group at tips of branches. *Cladobotryum.*

Conidia cylindric or fusiform, elongate.
Conidia acrogenous, single. *Acrocylindrium.*
Conidia several on the tips of the branches.
Tips of branches swollen. *Calcarisporium.*
Tips of branches uncinate. *Uncigera.*
Tips of branches neither swollen nor uncinate, sterigmata in a single row on one side. *Coemansia.*
Conidia and branches more or less surrounded by a gel.
Conidiophores several times verticillately branched. *Acrostalagmus.*
Conidiophores with an unbranched main axis on which the small side branches are borne.
Branches perpendicular, like sterigmata, simple with a small head of conidia. *Harziella.*
Branches short, ovoid, conidia single. *Gloiosphaera.*
Conidia borne in chains (see also *Penicillium*, etc.) *Spicaria.*

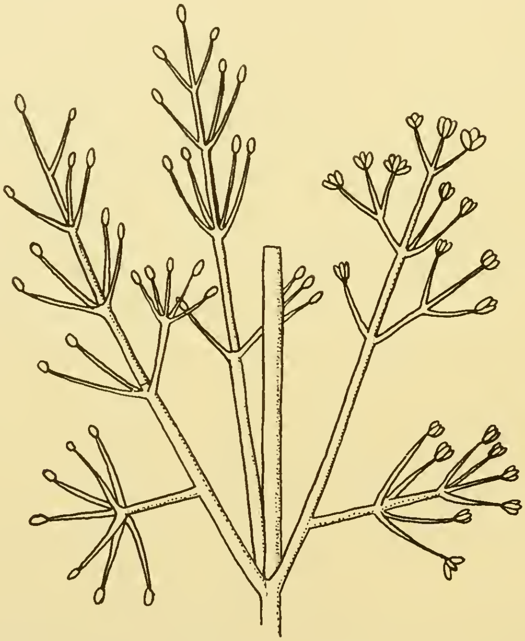

Fig. 134.—*Verticillium agaricinum* (Link) Corda. (After Harz.)

No clear-cut pathogens are yet known from this group. *Verticillium* is the only common contaminant (Fig. 134). The position of *Spicaria* is not clear. Some have considered *Scopulariopsis* a synonym, in which case it should be transferred to the Aspergillaceae. Some species were originally described as *Penicillium*. Many of the species have not been adequately figured, so that one cannot be sure that the spore chain is formed in the same way as that of the Aspergillaceae, but it is very likely that such is the case. For the present, we have retained it as a separate genus and are treating *Spicaria rubra* from corneal lesions at this point.

Spicaria rubra (Baquis) Dodge, n. comb.

Verticillium rubrum Baquis, Ann. di Ottalmol. **34**: 945, 946, 1905.

Isolated from lesions in cornea, keratomycosis. Not pathogenic to experimental animals.

Chains of ellipsoid spores hyaline, 5 × 15μ in diameter, arranged in verticils.

Colony whitish velvety, becoming rose (color of peach blossoms).

HAPLOGRAPHIEAE

Mycelium well developed, conidiophores differentiated; richly branched; conidia dark colored, in chains on tips of branches.

Key to Genera

Conidiophores erect, septate, each bearing a chain of conidia at its end. *Catenularia.*

Conidiophores branched at the tip, each branch bearing a chain of conidia. *Haplographium.*

Conidiophores bearing more or less branched chains of conidia.
  Conidiophores dendroid, branched; conidia spherical or ovoid. *Hormodendron.*
  Conidiophores ending in dichotomously branched conidial chains; conidia cylindric. *Hormiactella.*

CATENULARIA

Catenularia Grove in Saccardo, Syll. Fung. **4**: 303, 1886.

The type species is *Psilonia atra* Corda.

Conidiophores erect, septate, each bearing a chain of conidia at the tip; conidia brown, unicellular.

Catenularia fuliginea Saito, Jour. Coll. Sci. Imp. Univ. Tokyo **18**: **5**: 51, *Pl. 2, Fig. 4,* 1904.

Reported pathogenic by Joseph, Derm. Woch. **87**: 1396-1398, 1928. Isolated from excoriated plaques with crusts on hands of boy. Intracutaneous injection produced small abscesses in mouse, from which the organism was recovered. Lesions were experimentally reproduced on skin of man.

Mycelium dirty greenish color, with pleurogenous spherical spores, 4μ in diameter. Chlamydospores intercalary, up to 40μ in diameter, with spore chains of elongate spores in hanging drops.

On maltose agar, gray-brown colonies, becoming cacao brown.

This species is too poorly described to place definitely in this genus. One suspects that it might have been referred to *Dematium* with greater propriety. The author may have been misled by the usual figure of *Catenularia atra,* which shows free conidia in juxtaposition to the conidiophore, so that they might be mistaken for lateral conidia.

HAPLOGRAPHIUM

Haplographium Berkeley & Broome, Ann. Mag. Nat. Hist. III, **3**: 360, 1859.

The type species is *Haplographium delicatum* Berkeley & Broome.

Hyphae repent, often not seen; conidiophores erect, not branched, septate, brown, branching at the tip, each branch bearing a chain of spores, spherical or ellipsoid, green, brown, or almost hyaline, unicellular.

This seems to be a black analogue of *Penicillium,* but it has not been sufficiently investigated in the saprophytic species to know whether the terminal branches are metulae and phialides or not (Fig. 135). Apparently these are in the pathogenic species.

Haplographium DeBella-Marengoi Pollacci, Atti Ist. Bot. R. Univ. Pavia **18**: 125, 126, *Pl. 30,* 1921. [Case history, pathology, and cultural characters given by deBella and Marengo, in Giorn. Ital. Mal. Ven. Pelle **63**: 690-697, 1922.]

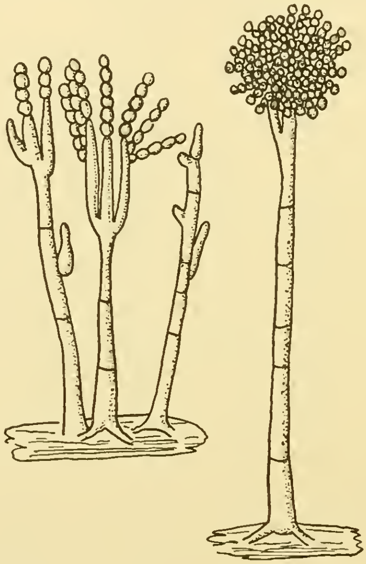

Fig. 135.—*Haplographium chlorocephalum* (Fresenius) Grove. (After Saccardo.)

Isolated from a gummatous cutaneous lesion on the jaw. Pathogenic to guinea pig and rabbit.

Mycelium septate, abundantly branched, at first hyaline, then brown. Sterile hyphae repent, branched, hyaline, then brown, 3-4μ in diameter; conidiophores repent or erect, simple septate, black, 50-80μ long, little or much branched above, phialides 10-12μ long, ending in chains. Conidia spherical or ovoid, black, smooth, 4-5μ in diameter, ends pointed.

Colony hemispheric, dirty white, then pea green with lanuginous center, then very dark grayish green. After 30 days, colony black, dry, rugose; reverse dirty white and then black. On glucose agar, colony black, zonate, orbiculate.

Var. **equinum** Pollacci, Riv. Biol. **10**: 358-367, 1928; Bolognesi & Chiurco, Micosi Chirurgiche, 904, 1927.

Isolated from *cancro del feltone.*

Differs from the species in host, conidiophores longer, conidia ovoid, 4.3 × 7.2μ.

Pollacci thinks the species of *Penicillium,* imperfectly described by Rebaudi & Podestà (1922), belongs in *Haplographium.* It certainly is not a *Penicillium.*

Var. **pulmonale** Redaelli, in Bolognesi, Atti Ist. Lombardo Sci. e Lett. 1925; Bolognesi & Chiurco, Micosi. Chirurg. 905, 906, 1927.

Spores ellipsoid, slightly apiculate or rounded, sometimes with lateral deformations; epispore thick, fuscous, 2.5-4.5 × 3.5-4μ. Differs from species with shorter branches bearing the chains and insertion of conidiophores, smaller ellipsoid conidia.

On carrot, colonies rounded, irregularly mammillate, elevated, dusty, velvety, grayish olive green, later confluent and darkening.

HORMODENDRON

Hormodendron Bonorden, Handb. allg. Mykol. 76, 1851.

The type species was not designated. Since Bonorden mentions the habitat of *Hormodendron olivaceum,* it is probable that he had seen a specimen, while in the case of the others, he apparently knew them only from Corda's figures. Hence *H. olivaceum* may be taken as the type (Fig. 136).

Hyphae repent, branched, septate. Conidiophores erect, septate, brown, branched. Conidial chains acrogenous on the branches; conidia spherical or ovoid, olive green or brown, unicellular.

In contrast to chains of spores in *Penicillium,* cell division occurs simultaneously throughout the greater portion of the branch; the cells round up and produce spores. Several pathogenic species have been reported. They make a well-marked group, quite distinct from other pathogenic genera. Whether or not the reference to *Hormodendron* is correct is still uncertain.

Hormodendron algeriensis Montpellier & Catanei, Ann. Derm. Syphiligr. VI, **8**: 626-635, 1927.

Found in lesions somewhat resembling those of sporotrichosis. On inoculation to rabbit, caused voluminous abscess.

Sterile hyphae brown, 4μ in diameter, septate. Sporophores erect, bearing little chains of spores. Cell wall with little thickenings or tuberosities from which spores are borne. Spores ovoid to elongate, 5.5-11 × 3-4μ, with wall thickened at point of attachment.

Colonies brown.

Hormodendron madagascarensis (Verdun) Dodge, n. comb.

Cladosporium sp. Guéguen, C. R. Acad. Sci. Paris **152**: 412, 413, 1911.

Cladosporium madagascarensis Verdun, Précis Parasitol. 1912.

Hormodendron sp. Langeron, Bull. Soc. Path. Exot. **15**: 443, 1922.

Isolated from ulcers on the leg of a Malgache, twenty-eight years old, which developed after a bath in a brook. The primary lesion healed promptly but, after a forced march, the leg broke out into confluent nodosities followed by ulcerous tumors, from which oozed a seropurulent liquid with a fetid odor. The whole area between foot and thigh was invaded. Aseptic puncture of fresh tumors gave a blackish bloody liquid from which, after 10 days, the organism was regularly recovered. In pus and in the hypertrophied connective tissue were numerous ovoid bodies, 3-4μ long, staining intense violet with Giemsa stain. Pathogenic to guinea pig and white mouse. Medication with KI ineffective.

Mycelium chocolate brown, pulverulent, plane becoming cerebriform; on carrot heaping up 1 cm. or more at point of inoculation. In hanging drop, the mycelium germinates oidium-like after 4 days, forming arbuscles of ovoid elements which decrease in size from base to summit of branches; later forming elongated conidiophores. On slices of carrot, oidia are almost at once replaced by hyphae, cylindric, flexuous, branched, tending to become verticillate, with the ultimate branches more or less breaking up to resemble oidia, reminding one of *Cladosporium penicillioides*. Oidia of first filaments germinating, 3-10 × 3-4μ. On solid media, cells of hyphae measure 2.5-3 × 15-25μ. Conidiiform cells of the long chains measure 3-4 × 2-4μ.

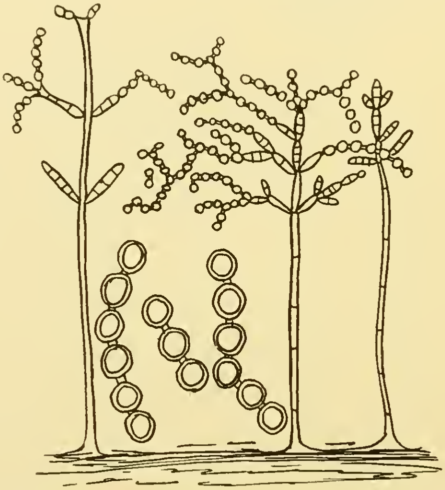

Fig. 136.—*Hormodendron olivaceum* Corda. (After Corda 1839.)

Hormodendron Fontoynonti Langeron apud Brumpt, Précis Parasitol. ed. 2, 1913; fide Langeron, Bull. Soc. Path. Exot. **15**: 436-443, 1922; footnote Fontoynont & Carougeau, Bull. Soc. Path. Exot. **15**: 424-435, 1922.

Found in hodi potsy or parasitic achromia in Madagascar.

Mycelium brown, septate, thick-walled, 2.5-7.8μ in diameter (mean 4μ on carrot). Sporophores well differentiated, dendroid. Chains of blastospores arise on tubercles or sides of last joint of conidiophore, the lower member of chain elongates and gives rise to chains of spores, easily breaking up into single cells. Blastospores ovoid, more or less elongate, unicellular or septate with a single septum, thick-walled, thickened at disjunctors, giving a somewhat citriform appearance, 5 × 3-8 × 4μ (Fig. 137).

Grows on usual media at room temperature, must be transferred in 15 days.

Hormodendron Langeroni Fonseca, Arêa Leão & Nogueiro Penido, Sciencia Medica **5**: 563-580, *2 pls.*, 1927.

Found in ulcero-nodular mycosis. On the lower part of the internal side of the right leg, and oval ulceration, about 3 cm. long, with sharply defined borders, in some places perpendicular to the skin surface, in other places the skin being more or less detached. The bottom of the ulcer is irregular, of dark red color, displaying a considerable purulent, malodorous secretion, the tissues under the ulcer edematous and infiltrated. Three small subdermic nodules noted, following a more or less straight line over the ulcer. These nodules are very painful. Wassermann positive. Clinically close to cutaneous lymphangitic type of sporotrichosis.

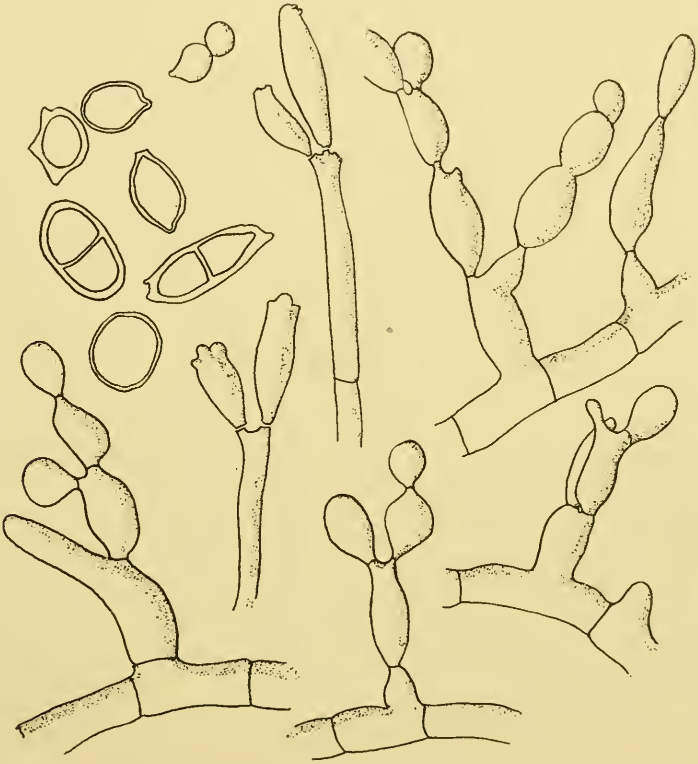

Fig. 137.—*Hormodendron Fontoynonti.* (After Fraga 1930.)

Aerial mycelium of septate, undulating hyphae, 2-4μ in diameter, sometimes anastomosing, sometimes with crystal deposits; conidiophores usually more or less branched, the branches composed of cylindric or elongated ovoid cells which are easily dissociated. The apical cell of the conidiophore, 7-12 × 3-4μ, bears a number of excrescences formed by a localized thickening of the wall. These excrescences bear cells in fascicles or whorls, which are clavate to more or less cylindric and produce chains of cells. The terminal cells of the chains, by repeated cell division, increase the length of the chains, the youngest spores at the ends. The typical spores are ovoid, 7-8 × 4-5μ (2.5-14 × 2.5-6μ), or navicular, both poles being provided with disjunctors, or one may be rounded.

Young colonies greenish, becoming dark green to black on most media. Growth smooth and moist, becoming cracked on drying out, sometimes covered with a thin layer of aerial hyphae. Colony form varies on different media, being subconic or crateriform on potato, smooth and confluent on carrot, often with radial furrows on agar. For further details, the original paper should be consulted.

Hormodendron leproides (Leger & Nogue) Dodge, n. comb.

Scopulariopsis leproides Leger & Nogue, Bull. Soc. Path. Exot. **15**: 654-661, 1922.

Isolated from two patients with mild lesions resembling leprosy, but without anesthesia.

Mycelium never a coremium. Hyphae 2.5-4μ in diameter, regularly cylindric, old branches tangled. Septa prominent, 10-15μ apart, branching without regular alternation, often at a 25° angle. Conidia easily scattered on simple or divided sporophores, 20-60μ long. Basal conidium ovoid, retained for a rather long time by a very loose pedicel. These conidial mother cells give rise to basipetal chains of varying lengths. False branchings may be alternate or verticillate but never as large as the aspergillar head. Phialides not seen. Conidia rounded or citriform, each carrying as ornamentations two slight elevations on the longest axis where chains break apart, 4-6μ in diameter. Membrane thick, nucleus easily stained.

Hormodendron rossicum Meriin, Arch. Derm. Syphilis **162**: 300-310, *5 figs.*, 1930.

Case by I. I. Cherniavski [Tschernjawski], Arch. Derm. Syphilis **157**: 196-206, 1929.

Found in dermatitis verrucosa, therapeusis effected by excision and medication with KI. Antigens not specific. Pathogenic to rats, injections causing ulcers which show an infiltration of diffuse mononucleate cells and newly formed vessels. In the center, there is an increase of giant cells and polymorphonuclears, with masses of spherical brown cells of the fungus which was reisolated from the experimental lesions.

Mycelium 2.6μ in diameter, terminal cells (conidiophores) 2.6-3.4 × 2.6μ, spherical or ovoid. Conidia ovoid, outer conidia smaller. Conidia in rosette of 3 or 4 short chains of 2-6 members on ends of conidiophores which are only the free ends of hyphal branches; pseudosclerotia formed. Original pus showed brown spherical cells; does not reproduce by budding.

Colonies on Sabouraud agar black, spherical, ovoid or irregular cells of deep greenish color, without mycelium. In subcultures, colonies are circular with raised center, black with a mouse gray velvet of young mycelium. Fascicles of hyphae appear. As culture becomes older, color becomes grayer, surface velvety and grooved. Growth good on bread or sugar agar, poor on rice, also on serum, where hyphae are not formed. Growth best at 37° C., very slow at room temperature. Growth good on the following medium: Peptone 2 gm., agar 2 gm., honey 8 gm., water 100 c.c. No gas on sugars. Slight acidity with sucrose, mannite, dulcite, galactose, maltose, glucose, or starch. Milk not coagulated, gelatin liquefied.

Doubtful Species

Oidium coeruleus cuticularis Greco, Argentina Méd. *5 pls.*, 1909; Origine des Tumeurs 54-63, *Figs. 11-14,* 1916.

Found on a young shepherd who was engaged in dipping sheep to cure them of the scab. Lesion began as red spots of desquamation, preceded by small vesicles arranged in the arc of a circle, gradually spreading to the forearms, pruriginous. Surface erythematous, red or somewhat lilac colored, slightly desquamatous, formed by the confluence of plaques still smaller, united more or less tangentially by their edges which are shown by the curved lines of small gray crusts, very adherent to a red surface, slightly redder than the central portions of the plaques covered with small furfuraceous grayish white scales.

Cells spherical or ovoid, about 6μ in diameter, forming filaments $8\text{-}10 \times 4\mu$, in 24 hours, which elongate to 120μ long by 1μ thick. Cells $5\text{-}6\mu$ long. Filaments variously branching, spores terminal on branches, with whole filament later breaking up into arthrospores.

On Sabouraud glucose, growth is visible in 24 hours, colonies at 8 days 1 cm. in diameter, elevations 2-3 mm., color olive green, umbilicate with elevated margin, finally becoming dark green, almost black; dry and separating from the medium with difficulty. Growth on Sabouraud maltose much the same as on Sabouraud glucose. Colonies on potato glycerol or plain potato abundantly cover the surface with a grayish, greenish olive color, powdered with black spores; liquid filled with flocculent floating colonies, with grayish olive centers and white margins; liquid finally covered with dark olive green pellicle, with a dirty gray powdery surface. Growth in broth or glycerol broth much the same as in the liquid of potato glycerol.

This organism is problematical. The lesion suggests *Epidermophyton* while the description of colony, with black spores, suggests *Hormodendron* or some organism of that group.

Blastomyces sp. Rudolf, Arch. Schiffs.-Tropenhyg. **18**: 498, 1914.

Found in the disease known as "*Figueira*" in Minas Geraes and Goyaz in Brazil (mossy foot?). Isolated from warts on back of foot causing a cauliflower papilloma. Pathogenic to monkeys and white rats.

Colonies on Sabouraud agar dark brown to black, of appearance of mouse skin.

PERICONIEAE

Mycelium well developed, conidiophores differentiated, ending in a vesicle; conidia black, not in chains.

Key to the Periconieae

Septa of conidiophore appearing as a black ring.	*Camptoum.*
Septa of conidiophore not as above.	
Conidia sessile on end of conidiophore, sterigma, if present, not highly developed.	
Conidia spherical to ovoid, tip of conidiophore more or less swollen.	*Periconia.*
Conidia elongate, tip of conidiophore not swollen.	
Conidiophore not branched.	*Gomphinaria.*
Conidiophore branched.	*Synsporium.*
Conidia borne on highly developed sterigmata.	
Conidia not embedded in a gel.	*Stachybotrys.*
Conidia embedded in a gel.	*Gliobotrys.*

GOMPHINARIA

Gomphinaria Preuss, Linnaea **24**: 130, 1851.

Acrotheca Auct. non Fuckel, Enum. Fung. Nassoviae 43, 1860.

The type species is *Gomphinaria amoena* Preuss.

Acrotheca was based on *Acrotheca Gei* Fuckel as a conidial stage of *Depazea geicola.*

Hyphae repent, not very evident above the substrate; conidiophore not branched, brown with simple, not swollen tip. Conidia fusiform to short cylindric, brown, several attached close together at the tip of the conidiophore, making a compact ball.

Only a single parasitic species has been reported from this genus whose species are saprophytic and rather rare.

Gomphinaria Pedrosoi (Brumpt) Dodge, n. comb.

Phialophora verrucosa A. Pedroso & J. M. Gomes, Bull. Soc. Med. Cir. São Paulo **3**: 254, 1920; Gomes, Ibid. **3**: 42, 43, *1 pl.,* 1920; Ann. Paulistas Med. Cir. **11**: 53-61, *Pls., 1-5,* 1920; not Medlar, Mycologia **7**: 200-203, 1915.

Hormodendrum Pedrosoi Brumpt, Précis Parasitol. ed. 3, 1921.

Acrotheca Pedrosoi Fonseca & Arêa Leão, C. R. Soc. Biol. **89**: 762, 763, 1923.

Trichosporium Pedrosoanum Ota, Jap. Jour. Derm. Urol **28**: [4], 6, 1928.

Found in nodular ulcers in a case suspected of leprosy at first. Warts covered by whitish crust which on removal leaves bleeding papillomatous surface.

Mycelium black, septate, branched. Conidiophores slightly larger above, bearing a tuft of 3-15 ovoid or subfusiform spores more or less adhering in a gel (Fig. 138).

Colonies on Sabouraud agar black, smooth, penetrating the medium, crateriform, later covered by a dark, ashy pubescence. On Loeffler's medium, growth slow, colonies flat, with irregular margins not penetrating the medium, no pubescence. On potato, colonies poor with long ashy tufts. Conidia production best on Dox & Czapek agar according to Fonseca.

HYALODIDYMEAE

Conidia hyaline, 2-celled, elongate, ovoid, clavate, or pyriform.

Only one species of *Diplosporium* has been reported to be pathogenic, but the following key is included since, very frequently, species of *Trichothecium* and *Arthrobotrys* appear in cultures as contaminants.

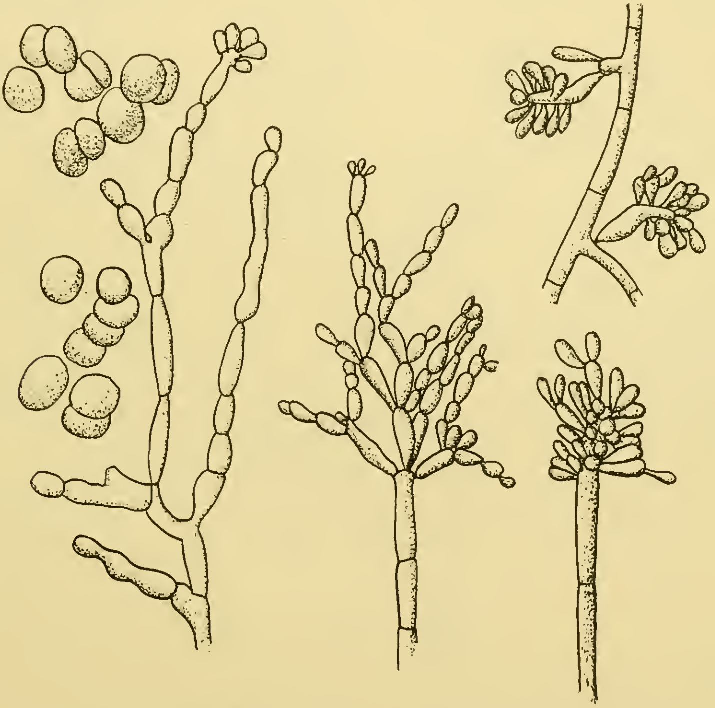

Fig. 138.—*Gomphinaria Pedrosoi.* (After Langeron 1929.)

Key to Genera

- Conidia single, not in chains.
  - Both cells of the conidium similar, smooth.
    - Conidiophores rarely or not at all branched.
      - Conidia typically pleurogenous
        - Conidia arranged singly in a helix about the conidiophore. *Haplariopsis.*
        - Conidia in whorls (Fig. 139). *Arthrobotrys.*
      - Conidia terminal.
        - Conidia borne on sterigmata. *Diplorhinotrichum.*

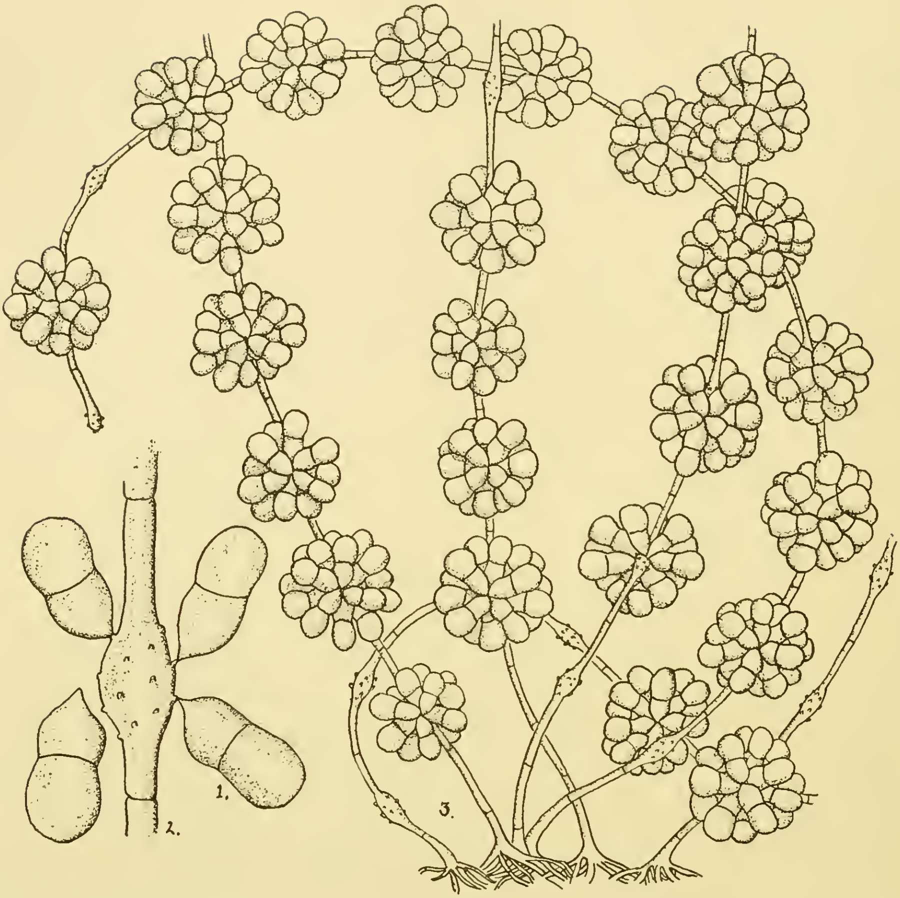

Fig. 139.—*Arthrobotrys superba* Corda. *1*, conidium; *2*, swollen conidiophore; *3*, habit sketch. (After Corda 1839, 1840.)

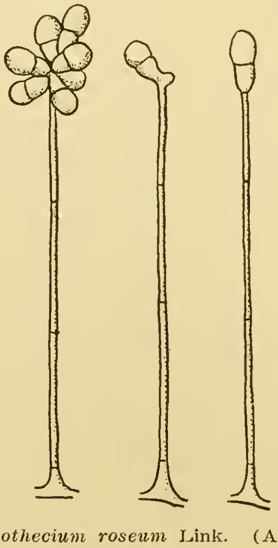

Fig. 140.—*Trichothecium roseum* Link. (After Matruchot.)

Conidia sessile.
    Conidia clavate or pyriform, cells more or less equal.
        Conidiophores not differentiated, conidia clavate, single. *Didymopsis.*
        Conidiophores differentiated, conidia pyriform, either single or in small heads (Fig. 140). *Trichothecium.*
    Conidia neither clavate nor pyriform, cells about equal. *Diplosporium.*
  Conidiophores branched in whorls as in *Verticillium.* *Diplocladium.*
 Conidial cells wholly dissimilar, at least the upper warted. *Mycogone.*
Conidia in chains.
 Conidia formed as oidia on the conidiophore, which is small and irregularly branched. *Hormiactis.*
 Conidia formed as chains from the tips of conidiophores, which branch in whorls. *Didymocladium.*

DIPLOSPORIUM

Diplosporium Link, in Linné *Sp. Pl.* ed. 4 [Willdenow] **6**: 1: 64, 1824; Bonorden, Handb. allg. Mykol. 98, 1851.

The type species is *Diplosporium nigrescens* Link.

Mycelium of repent, septate, branched hyphae; conidiophores erect, irregularly branched, bearing terminal, two-celled conidia.

It is quite likely that considerable shifting of names will occur in this group unless action is taken at the next International Congress. Originally Link proposed this genus apparently in the sense of *Cladotrichum* of the current monographs, in which case the latter name should fall into synonymy with *Diplosporium*, and the species now placed in *Diplosporium* should be renamed, if it is decided to separate black-spored and hyaline-spored groups. Most modern monographers have apparently considered *D. album* Bonorden the type of *Diplosporium*.

Diplosporium vaginae Nannizzi, Atti R. Accad. Fisiocrit. Siena IX, **17**: 491-499, *1 fig.*, 1926.

Found in purulent vaginitis.

Heads broadly effused, confluent, white, then pale ivory. Hyphae 3-6μ in diameter, ramulose, septate, conidiophores simple, subterete, 50-80 × 2.5-3μ, apex a little head of conidia stuck together. Conidia oblong-elliptic, almost subfusiform, 1-septate, constricted at septum, 15-20 × 5-6μ, hyaline; chlamydospores short, pedicellate, rarely sessile, 1-celled, adnate to a globulose or hemispheric vesicle, others bi- to pluricellular, wall thick, verruculose, 30-35μ, hyaline, sometimes in single chains (Fig. 141).

Colony round, mammillate, lanuginous, white, covering surface of medium.

PHAEOPHRAGMIAE

Conidia ovoid, elongate, cylindric, fusiform, straight or curved, with two or more septa, dark colored; occasionally single cells almost hyaline.

Key to Genera

Conidia verticillate.	
Conidia acrogenous.	
Conidia subhyaline.	*Acrothecium.*
Conidia black.	*Cacumisporium.*
Conidia acropleurogenous.	
Conidia curved, with the median cell longer and darker.	*Acrotheciella.*
Conidia straight, with the cells about equal.	*Spondylocladium.*
Conidia not verticillate.	
Conidiophores short and soft.	*Napicladium.*
Conidiophores long and quite rigid.	*Brachysporium.*

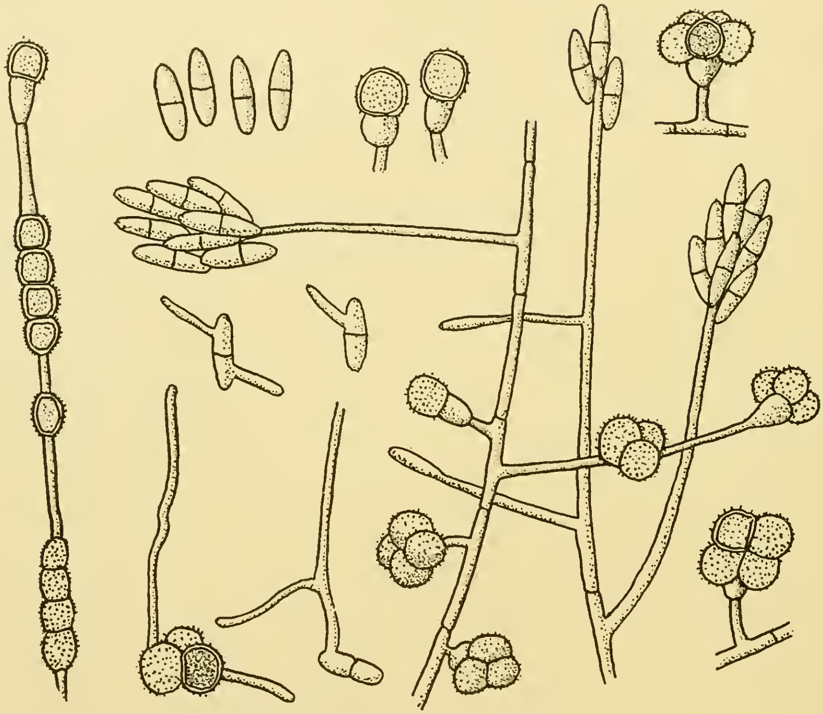

Fig. 141.—*Diplosporium vaginae.* (After Nannizzi 1926.)

ACROTHECIUM

Acrothecium Preuss, Linnaea **24**: 111, 1851.

? Acrothecium Corda, Icon. Fung. **2**: 10, 1838 (as subgenus only).

The type species is *Acrothecium multisporum* Preuss.

Hyphae repent, not abundant. Conidiophores erect, unbranched, with a group of sterigmata at the tips, bearing a head of conidia. Conidia elongate, fusiform, dark colored or hyaline, with two or more septa.

Acrothecium nigrum Ciferri, Ann. Parasitol. Hum. Comp. **7**: 524-535, 1929.

Isolated by Ochoterena from a case of black pinta in Mexico.

Mycelium of thick brown hyphae and hyaline slender hyphae, with intercalary hypnospores, forming chains of varying lengths. Conidiophores simple or sparingly branched, erect, light brown, short, denticulate, with a black, small head, acrogenous or nearly so; conidia rarely single, usually 2-20 in a head, 1-4-celled, usually 3-celled, pyriform, ellipsoid, ovoid, at first subclavate, subhyaline 1-celled, then septate, brown, with the middle cells darker and the end cells smaller and much lighter, base acute truncate, 16-30 × 6-11μ, mostly 22-26 × 8-9μ (Fig. 142).

On Sabouraud agar, colonies velvety, gray to black, compact, pigment diffusing into the agar.

Acrothecium obovatum Cooke & Ellis var. **subcapitulatum** Ashford & Ciferri, Mycologia **22**: 180-185, *2 figs.*, 1930.

Saprophyte on human skin.

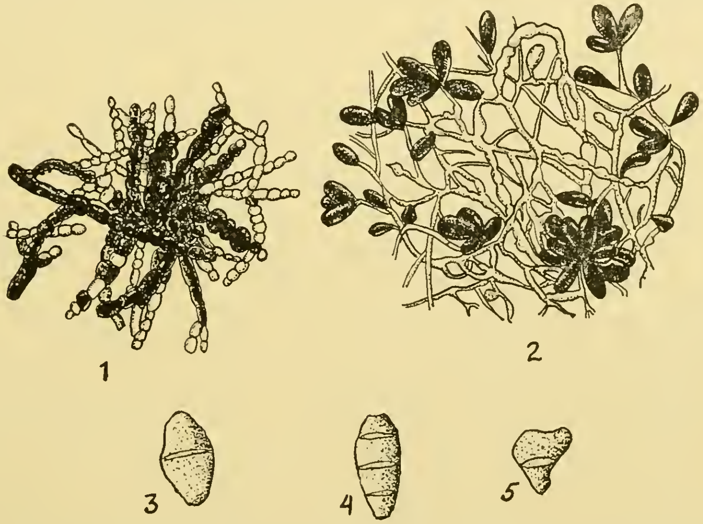

Fig. 142.—*Acrothecium nigrum.* *1,* sprout mycelium; *2,* Conidiiferous mycelium; *3, 5,* abnormal conidia spores; *4,* normal conidia. (After Ciferri 1929.)

SPONDYLOCLADIUM

Spondylocladium Martius, Flor. Cryptog. Erlang. 355, 1817.

The type species is *Spondylocladium fumosum* Martius.

Sterile hyphae repent, septate; conidiophores erect, unbranched, stiff and dark colored; conidia verticillate, several septate, brown.

Spondylocladium atro-olivaceum Neves, Mem. Inst. Oswaldo Cruz **25**: 323-331, *Pls. 85, 86,* 1931.

Isolated from small furunculoid abscesses in the middle portion of the naso-genal region, following an automobile accident. An intense inflammatory reaction and induration, suggesting sporotrichosis, Brazil.

Conidiophores 34-55μ, dark chestnut in color, septate, rigid, erect; conidia clavate fusiform, ovoid or subovoid, either constricted or not in the middle, ends acute or rounded, short pediceled or sessile, easily caducous, dark chestnut at maturity, 7-10.5 × 2-5μ; sterile hyphae septate, aerial hyphae dendroid, creeping.

Colony olivaceous, becoming very intense and finally black, filamentous at first, becoming glabrous in old cultures. Colonies on Sabouraud maltose have centers elevated, with radial furrows, some coremia in central portion, deep olive buff to dark olive buff, more or less zonate. On Sabouraud honey, center elevated, umbilicate, 4 radial furrows, from dark olive buff to dark olive, diffusing Saccardo's umber into the medium. On Sabouraud glucose, deep olive buff to dark olive, diffusing natal brown into the medium, reverse becoming olive brown. On potato glycerol, colonies mammillate, deep olive buff to dark olive buff, diffusing avellaneous or wood brown into medium. On carrot glycerol, growth similar to that on potato, citrine drab to deep olive, diffusing buffy brown into medium. On horse dung, small tufts, citrine drab. On rice grains, olive buff.

PHAEODICTYEAE

Mycelium dark colored, at least in age, conidiophores either simple mycelial branches or more highly specialized; conidia more or less muriform, dark colored, quite variable in form.

Key to Subtribes

Conidiophores on differentiated hyphal branches.	*Micronemeae.*
Conidiophores definitely differentiated.	
Conidia single on the tip of the conidiophore.	*Macrosporieae.*
Conidia in a head at the tip of the conidiophore.	*Dactylosporieae.*
Conidia in chains or growing quite irregularly.	*Alternarieae.*

This group is largely saprophytic or parasitic on plants hence reports of human pathogens should be studied very critically before they are admitted. Considerable evidence has been accumulating that *Alternaria* (especially *A. tenuis*) is important in some cases of allergy (see Brown 1932).

ALTERNARIA

Alternaria Nees ab Esenbeck, System der Pilze 72, 1817.

Sterile hyphae creeping, septate; conidiophores single or in small bunches, septate not branched, short; conidia inverted, clavate, usually with an elongate lighter tip, muriform and darker color below, mostly joined in long simple chains.

The type species is *Alternaria tenuis* Nees ab Esenbeck.

Alternaria tenuis Nees ab Esenbeck, System der Pilze 72, *Fig. 68,* 1817.

Recently Borsook (1933) repeatedly isolated a fungus identified as *Alternaria tenuis* Nees (Cf. Elliott, John A., 1917. Taxonomic Characters of the Genera Alternaria and Macrosporium, *Am. Jour. Bot.* **4**: 439-476, *Pls. 19, 20*). The lesions occurred following a splinter in the hand of a Roumanian Jewess in Canada. The lesions were dark macular, pustular and ulcerating, with scaly centers on forearm; they tended to heal spontaneously only to reappear over a period of 16 years.

Macroconidia 4-8-celled with only transverse septa, or fusiform with both longitudinal and transverse septa, varying from "the size of a single leucocyte to that of 8-10."

Optimum temperature 25° C., aerobic or aquatic aerobic. On Sabouraud agar, colony white, becoming brownish black in 3 weeks after conidia are produced. In subcultures conidia are produced much sooner, often in 5 days. On serum glucose agar, pellicle formed at surface. On beef broth a pellicle was produced.

In the foregoing description there is little to prove identity with *Alternaria tenuis* Nees. The lesions suggest those produced by *Hormodendron* or *Spondylocladium*. It is hoped that Borsook will follow his account by a more complete description of the organism and appropriate figures.

STILBACEAE

Vegetative hyphae in or upon the substrate, septate, branched, hyaline or dark colored. Fertile hyphae in parallel strands forming coremia which bear conidia at their tips. The ends of the coremia often form differentiated heads on which the conidia are borne; in other forms the conidia are borne along the stalk as well. The stalk may be either simple or branched.

The group is artificial, as coremia are formed by various groups of fungi, especially in old cultures and are often overlooked. In this case the organism would be placed among groups on the basis of its conidia without reference to coremia. In this work, organisms have been classified without reference to coremial production, but below a key to genera of Stilbaceae has been provided, together with indications of the position of various organisms treated previous were they to be treated in this family. *Stysanus,* bearing a brown coremium, often appears in cultures as a contaminant.

Key to Genera

Conidia, coremia, and hyphae hyaline or bright colored.	HYALOSTILBOIDEAE.
Conidia unicellular, hyaline, or bright colored.	
Conidia in chains.	*Coremium.*
Conidia not in chains.	
Conidia bacilliform.	*Clavularia.*
Heads not differentiated, conidia borne over whole surface.	*Isaria.*
Heads differentiated partially, conidia only on the top.	*Ciliciopodium.*
Heads differentiated.	
Each stalk bearing a single terminal head.	
Conidiophores simple.	*Stilbella.*
Conidiophores branched.	*Dendrostilbella.*

Stalks with lateral as well as terminal heads.
Conidia in heads as in *Cephalosporium*. *Tilachlidium.*
Conidial heads resembling *Aspergillus*. *Gibellula.*
Conidia 2-celled, elongate, hyaline. *Didymostilbe.*
Conidia several-celled, elongate, hyaline.
Conidia in chains. *Symphyosira.*
Conidia not in chains.
Conidia ovoid. *Arthrosporium.*
Conidia curved. *Atractium.*
Coremia and hyphae dark colored, conidia hyaline or dark colored. PHAEOSTILBOIDEAE.
Conidia unicellular, hyaline or dark colored.
Conidia not in chains.
Coremia composed of both hyaline and dark hyphae *Ceratocladium.*
Coremial hyphae uniform.
Heads solid, formed of conidiophores.
Heads without spines. *Sporocybe.*
Heads with spines. *Saccardaea.*
Heads formed by spreading of stalk hyphae and spores.
Conidia ovoid or ellipsoid. *Graphium.*
Conidia elongate, curved. *Harpographium.*
Conidia in chains.
Coremia with more or less definite heads or discs.
Conidia spherical.
Coremia with heads. *Briosia.*
Coremia with discs. *Heydenia.*
Conidia elongate. *Antromycopsis.*
Coremia spreading brush or broom-shaped.
Coremia fleshy. *Stemmaria.*
Coremia not fleshy.
Conidia ovoid, stalk of equal thickness throughout its length. *Stysanus.*
Coremia fusiform, stalk thickened below. *Graphiothecium.*
Conidia two-celled, greenish or brownish. *Antromyces.*
Conidia several-celled, hyaline or brownish.
Coremia of agglutinated, thick-walled hyphae, dark colored. *Arthrobotryum.*
Coremia of loosely tangled hyaline or brownish hyphae. *Isariopsis.*

Dendrostilbella Boydii Shear apud Boyd & Crutchfield, Amer. Jour. Trop. Med. **1**: 258-268, 1921; Mycologia **14**: 242, 1922.

Coremial stage of *Allescheria Boydii* Shear (see p. 652).

Tilachlidium Bogolepoffi Vuillemin, Bull. Soc. Myc. France **28**: 113-120, *Pl. 6*, 1912.

Coremial stage of *Cephalosporium Bogolepoffi* (Vuillemin) Dodge (see p. 830).

TUBERCULARIACEAE

In this family are assembled forms which regularly produce conidiophores and conidia on compact cushions, known as sporodochia. The group is somewhat artificial, and conidial forms vary greatly. The group contains a large number of plant pathogens and saprophytes. It is doubtful whether any important animal pathogens will be found here. In the four species so far reported, three are so briefly described that it is far from certain whether they belong in this group rather than in *Blastotrichum* or *Septocylindrium*. *Fusarium Moronei* Curzi may have been a saprophyte accidentally present, but it has been shown to be pathogenic. This seems a true *Fusarium*, of which there are several hundred species described as plant pathogens.

Fusarium Moronei Curzi, Atti Ist. Bot. R. Univ. Pavia IV, **1**: 95-105, *2 figs.*, 1930; Atti R. Accad. Naz. Lincei. Rend. Cl. Sci. Fis. Mat. Nat. **11**: 506-508, 1930.

From skin lesions of a dog. *Mucor racemosus* isolated from the same lesion. Lesions begin as subepidermal vesicles which become infiltrated. Pathogenic to white rats.

Conidia falcate, end cells very attenuate; apical cell often extended into a flagellum, the basal cell ending in a conspicuous pedicel; typically 5-septate, 34-60 × 3.7-4.5μ, not less than 3-septate nor more than 7-septate. Sporodochia commonly tuberculiform, 0.5-2.5 mm. in diameter, pale yellow or even pseudopionnotes on the bare surface of the substrate; or on fertile aerial hyphae either sparse or crowded. Intercalary chlamydospores always present in the mycelium, smooth or variously rugose, solitary or more often in chains or in various formless masses. Sclerotia rare, at first creamy white, then ferruginous, spherical, 0.5-2 mm. in diameter, composed of plectenchyma. Aerial mycelium abundant, at first white or rose color, then ochraceous, at length ferruginous from the numerous chlamydospores. No microconidia seen.

Fusarium vinosum Greco, Origine des Tumeurs . . . 662-670, *Pl. 17,* 1916.

Isolated from lesions on nose, small nodular papules red yellowish lilac, with yellowish gray crusts, confluent. Rabbit died after inoculation, but author unable to isolate organism. Perhaps death caused by toxic products from disintegration of inoculum.

Mycelium 2-4μ in diameter, branched, septate. Chlamydospores ovoid, up to 6μ long, or cylindric, 6 × 10μ. Conidia falciform, fusiform, 8-11 × 2-4μ, up to 7 cells.

Colonies yellowish white, reverse rose, growth rapid, cottony, agar becoming red. On Sabouraud agar, colonies radiate, red, slightly violaceous, growing to 2.5 cm. in 3 days, loose cottony, grayish white above, slightly yellowish at certain points. On carrot, the rose color is less pronounced and on potato the cottony growth is whiter. The organism grows, forming a thick, folded pellicle on glucose peptone broth, to which the juice of a potato has been added and filtered.

This organism is too poorly described and figured to be identifiable as a *Fusarium*. The rather poor photomicrograph suggests *Endomyces, Coccidioides* or a similar organism, although no yeast cells were observed.

Fusarium sp. Frei, Derm. Woch. **80**: 411-414, 1925.

Patient 15-16 years old, contracted gonorrhea, which he treated at home with injections of cow's milk. Later he noticed turbid urine, 4 months before acute gonorrheal urethritis, epididymitis, and prostatitis developed. Gonococcus disappeared in 14 days under the above-mentioned treatment. Examination showed small white star-shaped colonies of mycelium in posterior urethra. The fungus is evidently a saprophyte as secondary invader. Therapy: $AgNO_3$, 1-2%, applied directly to colonies with urethroscope.

Spores cylindric to sickle-shaped, with or without septa, usually in groups of 2-8. Chlamydospores also present.

Colonies dry, sunk in substratum, separable with difficulty, center umbonate with radiating furrows, dull yellow to red brown, color diffusing into medium. At 37° C., little aerial mycelium; at room temperature, much aerial mycelium, which is white on gelatin. Growth good on broth, malt extract, milk, litmus milk, or urine, of star-shaped flocculi which both float and sink to form sediment. Gelatin not liquefied. Glucose and lactose not fermented. Milk peptonized.

Fusariopsis Derrieni Parreiras Horta, Brasil Med. **33**: 395, 1919 (nom. nudum); Tribuna Med. Rio de Janeiro **25**: 233-256, 1919.

Isolated from a case clinically diagnosed as diphtheria in Carrieu's clinic in Montpellier. False membranes and white points on uvula and left tonsil. Author unable to cultivate.

Conidia fusiform, unicellular or 1-septate. Mycelium present. *Fusariopsis* was separated from *Fusarium* solely on basis of human pathogenicity.

Unknown or of Doubtful Position

The following species are either too poorly described to place definitely or are known to me only by mention in secondary sources.

Sarcinomyces Inkin Oho, mentioned by Ota, Jap. Jour. Derm. Urol. **28**: [4], 1928.

Found on scrotum, in Formosa.

Adenomyces Cruzi Dias 1917.

Montoyella Bodini Castellani 1907; Castellani & Chalmers, Man. Trop. Med. ed. 2, 799, 1913.

Colonies whitish or greenish.

Reported by Castellani & Chalmers, 1913, from red pinta [p. 1514].

Mucor mycetomi Gelonesi, Ann. di Med. Nav. Colon. **33**: 283-308, *8 figs.*, 1927.

Isolated from a black grain mycetoma in Somaliland.

When liquid from lesions was planted, tubes mostly remained sterile. Very rapid growth on banana, with "physiologic" serum at bottom of tube. Colonies ochre yellow, smooth, humid, adherent to the substrate, confluent, forming milky white, humid, dense pellicle. After two months, a white, cottony growth, 2-4 mm. above, hyphae erect, terminated by a black round little grain. The moist, mucous, waxy layer is composed of hyphae, 4-5μ in diameter, densely interwoven, possessing granular protoplasm, regularly and frequently septate with branching both dichotomous and at various angles including right angle, with terminal hypnospores. In the cottony layer hyphae 8-10μ, hyaline, septate, branches, sporangiophores 10-12μ, granular, rarely septate or lateral branching. Sporangium 40-50μ long, spores spherical or ovoid, variable in size. Sporangium with black pigment granules. Columella evanescent!

N.B. In none of the other media is the first type of colony produced.

BIBLIOGRAPHY

Agostini, Angela. 1930. Glenosporella dermatitidis n. sp. causa di dermatomicosi umana, *Atti Ist. Bot. R. Univ. Pavia* IV, 2: 93-101.

—. 1931. On Blastomycoides lanuginosus Castellani, *Jour. Trop. Med. Hyg.* 34: 287, 288, *2 figs.*

—. 1931. Ricerche biologiche sull' Acrostalagmus cinnabarinus Corda, *Atti Ist. Bot. R. Univ. Pavia* IV, 3: 77-84.

—. 1932. Observations on fungi found in cases of North American blastomycosis of the skin and lungs, *Jour. Trop. Med. Hyg.* 35: 266-269, *3 figs.*

Anderson, Charles. 1925. Sur quatre nouvelles observations tunisiennes de mycétome, *Arch. Inst. Pasteur Tunis* 14: 90-92.

Anderson, Charles, R. Brocq & Cassar. 1926. Deux nouvelles observations tunisiennes de mycétome, *Arch. Inst. Pasteur Tunis* 15: 332-335.

Arêa Leão, A. E. 1923. Chromoblastomycose (dermatite verrucosa mycotica). Observação de um novo caso, *Sciència Med.* 1: 227, 228, *1 pl.*

Aroeira Neves. 1929. Onychomycose (?) por Acrotheca Pedrosoi (Brumpt, 1921), *Brasil-Med.* 43: 69, 70.

Aschieri, Eugenia. 1931. Ricerche sistematiche e fisiologiche su un Hyalopus causa di onicomicosi, *Atti Ist. Bot. R. Univ. Pavia* IV, 3: 45-63, *8 figs.*

Ashford, Bailey K. & Raffaele Ciferri. 1930. A new variety of Acrothecium obovatum, *Mycologia* 22: 180-185, *2 figs.*

Balina, Pedro L. & Pablo Negroni. 1932. Intertrigo des orteils et onyxis dus à un nouveau parasite, *Ann. Derm. Syphiligr.* VII, 3: 8-20, *10 figs.*

Baquis, E. 1905. Una nuova forma di Cheratomicosi, *Ann. di Ottalmol.* 34: 945-947.

Baudet, E. A. R. T. 1930. Sur une souche d'Aleurisma lugdunense isolée de la peau d'un dromedaire, *Ann. Parasitol. Hum. Comp.* 8: 628-637, *3 figs.*

Bella, A. de & G. Marengo. 1922. Di un nuovo micete (Haplographium DeBella-Marengo) e delle lesioni cutanée con esso in rapporto, *Giorn. Ital. Mal. Ven. Pelle* 63: 690-697, *1 pl.*

Benedek, T. 1928. Über Cephalosporiose. Ein Beitrag zur Kenntnis der seltenen Mykosen unter besonderer Berücksichtigung der Serumdiagnose, *Arch. Derm. Syphilis* 154: 96-107.

—. 1928. Vergleichende Untersuchungen über einige Arten der Gattung Cephalosporium nebst Mitteilungen einer neuen Art: Cephalospor. niveolanosum nov. spec., *Arch. Derm. Syphilis* 154: 154-167, *11 figs.*

—. 1929. Ist das Cephalosporium asteroides griseum Gruetzii (Grütz 1925) Benedek emend. 1927 mit dem Cephalosporium Acremonium Corda 1839 identisch? *Derm. Woch.* 88: 892-897, *7 figs.*

Benham, Rhoda W. 1931. Phoma conidiogena an excitant of asthma; some observations on the development and cultural characteristics, *Bull. Torrey Bot. Club* 58: 203-214, *3 pls., 8 figs.*

Berti, Giuseppi. 1922. Sopra due nuove specie di miceti del corpo umano Acremoniella Bertii n. sp.—Penicillium Burci n. sp., *Policlinico. Sez. Chirurg.* 29: 484-489.

Beyma thoe Kingma, F. H. van. 1933. Ein unbekanntes pathogenes Cephalosporium, Cephalosporium Stühmeri Schmidt et van Beyma, *Centralbl. Bakt.* I, 130: 102-105, *3 figs.*

Blankenhorn, M. A. & John A. Gammel. 1926. Generalized mycosis of a hitherto undescribed form, *Trans. Ass. Amer. Physicians* **41**: 268-282, *9 figs.*

—. 1927. Generalized mycosis due to a hitherto undescribed fungus (Glenospora Gammeli), *Jour. Clin. Invest.* **4**: 471-484, *9 figs.*

Bolognesi, Giuseppe. 1923. Micosi chirurgiche sperimentali, *Pathologica* **15**: 374, 375, *2 figs.*

Borsook, M. E. 1933. Skin infection due to Alternaria tenuis (with the report of a case), *Canad. Med. Ass. Jour.* **29**: 479-482, *3 figs.*

Boucher, Humbert. 1918. Mycoses gommeuses de la Côte d'Ivoire, *Bull. Soc. Path. Exot.* **11**: 306-338.

Buschke, Abraham & A. Joseph. 1928. Dermatitis verrucosa (chromoblastomykose), *Derm. Woch.* **87**: 1047-1049.

Cadham, F. T. 1924. Asthma due to grain rusts, *Jour. Am. Med. Ass.* **83**: 27.

Carini, A. 1924. Sur la dermatite verruqueuse, *Bull. Soc. Path. Exot.* **17**: 227-233, *Figs. 1-3.*

Castellani, Aldo. 1916. Notes on a new ulcerative dermatomycosis with report on the causative fungus by Professor E. Pinoy, *Brit. Med. Jour.* **2**: 486, *Pl. 1.*

—. 1917. Acladiosis, *Proc. Roy. Soc. Med.* **11**: *Derm:* 12-18, *9 figs.*

Catanei, A. & P. Goinard. 1934. Un nouveau cas algérien de mycétome du pied, *Bull. Soc. Path. Exot.* **27**: 176-178, *2 figs.*

*Cavalcanti, J. T. de M. 1924. Contribuicão ao estudio das chromoblastomycoses, *Thesis, Fac. Med. Rio de Janeiro.*

Cherniavski, Ivan. [Tschernjawski, Johann.] 1929. Chromoblastomycosis, *Arch. Derm. Syphilis* **157**: 196-206.

Ciferri, Raffaele. 1929. Sur un Acrothecium isolé du mal del pinto mexicain, Acrothecium nigrum n. sp., *Ann. Parasitol. Hum. Comp.* **7**: 524-535.

—. 1932. Cephalosporium pseudofermentum n. sp. isolato dalla bocca dell'uomo, *Arch. Protistenk.* **78**: 227-237, *Pl. 1.*

Ciferri, Raffaele & Bailey K. Ashford. 1930. A new Porto Rican species of Acremoniella, *Mycologia* **22**: 62-68, *2 figs.*

Costantin & Rolland. 1889. Blastomyces, genre nouveau, *Bull. Soc. Myc. France* **4**: 153-156, *Pl. 23.*

Craik, R. 1923. Acladium Castellanii Pinoy, *Jour. Trop. Med. Hyg.* **26**: 184-186.

Curzi, Mario. 1930. Intorno alla posizione sistematica di un Fusarium isolato dalla pelle del cane, *Atti Ist. Bot. R. Univ. Pavia* IV, **1**: 95-105, *2 figs.*

—. 1930. Prime osservazioni su la mutazione di un ifomicete, *Atti R. Accad. Naz. Lincei, Rend. Cl. Sci. Fis. Mat. Nat.* **11**: 506-508.

—. 1930. Su la mutazione di un ifomicete (Fusarium Moronei), *Atti Secondo Congr. Naz. di Microbiol. Soc. Internaz. di Microbiol. Sez. Ital.* **8**: 49-52.

Englehardt, Willy. 1924. Über zwei Fälle von Hauterkrankungen, hervorgerufen durch ein sporotrichonartiges Monosporium, *Derm. Woch.* **79**: 1405-1414, *11 figs.*

Fonseca filho, Olympio Oliveiro Ribeiro da & A. E. de Arêa Leão. 1923. Sur la systématique des champignons produisant des chromoblastomycoses, *C. R. Soc. Biol.* **89**: 762, 763.

—. 1927. Sobre o Scedosporium apiospermum cogumelo productor de mycetomas na Italia e no Brasil, *Bol. Inst. Brasileiro Sci.* [Rio de Janeiro] **3**: 24, 25.

—. 1927. Sur un cas d'acladiose à Acladium Castellanii observé au Brésil, *C. R. Soc. Biol.* **97**: 1361, 1362.

*—. 1930. Chromoblastomycose, *Bol. Acad. Nac. Med. Rio de Janeiro* **101**: 18-40; **Medicamenta* **9**: 28.

*—. 1930. Las cromoblastomycoses, *Rev. Med. Cirurg. Brasil* **38**. *Reunión Soc. Argentina Pat. Regional del Norte* **5**: 328.

Fonseca filho, Olympio Oliveiro Ribeiro da, A. E. de Arêa Leão & J. C. Nogueira-Penido. 1927. Mycose de typo ulcero-nodular, semelhando a esporotrichose e produizida por uma especie de cogumelo do genero Hormodendrum, *Sciencia Med.* **5**: 563-573, *2 pls.*

*Fonseca filho, Olympio Oliveiro Ribeiro da & Eduardo Rabello. 1927. Uma mycose rara: Acladiose pelo Acladium Castellanii, *A. Pathologia Geral.*

Fontoynont, Maurice & Humbert Boucher. 1923. Contribution à l'étude des mycoses de Madagascar, *Ann. Derm. Syphiligr.* VI, 4: 209-235; 318-344, *10 figs.*

Fontoynont, Maurice & J. Carougeau. 1922. Étude sur le Hodi-potsy, dermatomycose malgache, *Bull. Soc. Path. Exot.* 15: 424-436.

Fraga, Arminio. 1930. Sobre um caso de dermatite ulcero-nodular causada pelo Hormodendrum Langeroni, *Rev. Med. Cir. Brasil* 38: 321-329, *1 pl.* [English translation 330-336].

Frei, W. 1925. Urethritis posterior chronica mycotica, *Derm. Woch.* 80: 411-414.

Fresenius, G. 1850-1863. Beiträge zur Mykologie 1: 1-38, *Pls. 1-4,* 1850; 2: 39-80, *Pls. 5-9,* 1852.

Gammel, John A. & Alan R. Moritz. 1933. Experimental monosporosis, *Arch. Derm. Syphilol.* 27: 100-106.

Gay, Douglas M. & James B. Bigelow. 1930. Madura foot due to Monosporium apiospermum, *Amer. Jour. Path.* 6: 325-335, *Pl. 72.*

*Gomes, José María. 1920. Um novo caso de dermatite verrucosa, *Bull. Soc. Med. Cir. São Paulo* 3: 42, 43.

Gougerot, H., Burnier & J. Duché [histologie par Olga Eliascheff]. 1933. Mycose végétante et ulcéreuse due au Cephalosporium griseum, *Bull. Soc. Franç. Derm. Syphiligr.* 40: 417, 418.

Guéguen, Fernand. 1911. Mycose cladosporienne de l'homme, *C. R. Acad. Sci.* 152: 412, 413.

Hartmann, E. 1926. Über ein gemeinsames Vorkommen von Cephalosporium und Trichophyton gypseum, *Derm. Woch.* 82: 565-569.

Hopkins, J. G., Rhoda. W. Benham & Beatrice M. Kesten. 1930. Asthma due to a fungus—Alternaria, *Jour. Am. Med. Ass.* 94: 6-10, *1 fig.*

Horta, P. Parreiras. See Parreiras Horta, P.

Joseph, A. 1928. Über Befunde von Pilzen der Gattung Dematiaceae bei oberflächlichen Hautaffectionen, *Derm. Woch.* 87: 1396-1398.

Kawatsure, Shûji. 1933. Tierexperimentelle Untersuchungen über die Erreger von sogenannten amerikanischen Blastomykosen: Scopulariopsis americana, Aleurisma tulanense and Coccidioides immitis, *Arch. Derm. Syphilis* 169: 173-199, *11 figs.*

Landrieu, Marcel. 1912. Les mycoses oculaires, *Thèse de Paris,* 136 pp.

Lane, C. G. 1915. A cutaneous disease caused by a new fungus. Phialophora verrucosa, *Jour. Cutan. Dis.* 33: 840-846, *3 pls.*

Lang, Franz Josef. 1921. Durch Leptothrixinfektion bedingte Leberinfarcierung in einem Falle von callösem Ulcus duodeni, *Arch. Path. Anat. Physiol.* [Virchow] 234: 367-377.

Langeron, Maurice. 1913. Hormodendron Fontoynonti n. sp. et achromie parasitaire malgache, "*Arch. Parasitol.* 16:" [cited by Brumpt *Précis de Parasitologie* ed. 2, 1913, but never published due to war, therefore should be cited Langeron apud Brumpt. See Langeron, 1922, footnote.]

—. 1922. Hormodendron Fontoynonti Langeron 1913, agent de l'achromie parasitaire malgache, *Bull. Soc. Path. Exot.* 15: 436-443.

Leão, A. E. Arêa. See Arêa Leão, A. E.

Leinati, Fausto. 1928. Micosi rare in animali. Osservazioni cliniche esperimentali, *Atti R. Accad. Fisiocrit. Siena* X, 3: 83-92, *3 pls.*

—. 1928. Sull'azione patogena di una nuova specie di Fusarium (F. Moronei), *Riv. Biol.* 10: 141-154, *10 figs.*

Maciel, Jesuino. 1930. Contribuição a historia das chromoblastomycoses brasileiras, *Rev. Med. Cir. Brasil* 38: 3-8, *1 pl.*

Maffei, L. 1929. Nuova specie di Cephalosporium causa di una cheratomicosi dell'uomo, *Atti Ist. Bot. R. Univ. Pavia* IV, 1: 183-198, *9 figs.*

—. 1931. Micosi causata da una varietà di Halobyssus moniliformis Zukal, *Atti Ist. Bot. R. Univ. Pavia* IV, 3: 19-28, *10 figs.*

Magalhães, Octavio de. 1916. Aleurophora benigna n. g. n. sp., *Brasil-Med.* 30: 369, 370.

Mantarro, Giovanni. 1931. Epidermomicosi acromizzanti da Hemispora stellata, *Giorn. Ital. Derm. Sifilol.* 72: 131-143.

Margarinos Torres, G. 1927. Histologie pathologique de l'acladiose, *C. R. Soc. Biol.* 97: 1362-1364.

Matruchot, Louis. 1892. Recherches sur le développement de quelques mucédinés, *Thèse de Paris,* 111 pp., *8 pls.*

Matruchot, Louis & Ramond. 1905. Un type nouveau de champignon pathogène chez l'homme, *C. R. Soc. Biol.* 57: 379, 380.

Medlar, E. M. 1915. A new fungus, Phialophora verrucosa pathogenic for man, *Mycologia* 7: 200-203, *Fig. 1.*

—. 1915. A cutaneous infection caused by a new fungus, Phialophora verrucosa with a study of the fungus, *Jour. Med. Res.* 32: 507-521, *Pls. 29-33.*

Mendelson, Ralph W. 1920. A case of Castellani's Acladiosis, *Brit. Med. Jour.* 2: 664, *1 fig.* [Reprinted in *Jour. Trop. Med. Hyg.* 24: 86, 1921.]

Meriin, J. A. 1929. Gribok vydelennii iz sluchaia chromoblastomykoza, *Mater. Mykol. Fytopat.* 8: 90-100, *10 figs.*

—. 1930. Zur Mykologie der Chromoblastomykose (Der Erreger des europäischen Falles der Erkrankung), *Arch. Derm. Syphilis* 162: 300-310, *5 figs.*

—. 1932. Weitere Beobachtungen über den Erreger der europäischen Chromoblastomycosis, *Arch. Derm. Syphilis* 166: 722-729, *6 figs.*

Miller, Hiram E. & Howard Morrow. 1932. Cephalosporiosis, an unusual mycotic infection, *Arch. Derm. Syphilol.* 25: 294-303, *10 figs.*

Montpellier, J. 1922. Note biologique au sujet des mycétomes. Essais de vaccinothérapie, *Bull. Soc. Path. Exot.* 15: 7, 8.

—. 1924. Deuxieme cas algérien de mycétome du pied ("type Pied de Madura") dû à Aleurisma apiospermum, *Bull. Soc. Path. Exot.* 17: 755-757.

Montpellier, J. & A. Catanei. 1927. Mycose humaine due à un champignon du genre Hormodendron, H. algeriensis n. sp., *Ann. Derm. Syphiligr.* VI, 8: 626-635.

—. 1934. Resultats de l'étude d'un nouveau mycétome du pied observé à Alger, *Bull. Soc. Path. Exot.* 27: 209-214, *1 fig.*

Montpellier, J. & P. Gouillon. 1921. Mycétome du pied (type pied de Madura) dû à l'Aleurisma apiospermum, *Bull. Soc. Path. Exot.* 14: 285-290, *Pl. 1.*

Morax, V. 1910. Mycose de la cornée causée par le Verticillium Graphii, *Ann. d'Ocul.* 144: 323-335, *5 figs.*

Motta, Roberto. 1926. Miceti isolati da tumori della faringe e della laringe, *Atti R. Accad. Fisiocrit. Siena* IX, 17: 655, 656.

Nannizzi, Arturo. 1926. Osservazioni sul dimorfismo degli elementi riproduttori agamici in un nuovo Diplosporium (D. vaginae n. sp.) ed in altri generi di Hyphales, *Atti R. Accad. Fisiocrit. Siena* IX, 17: 491-499, *1 fig.*

—. 1931. Glenosporella, nuovo genere di Hyphales, *Atti R. Accad. Fisiocrit. Siena* X, 6: 268-273.

Negroni, Pablo. 1930. Una nueva mucedinaceae parásita del hombre, *Rev. Soc. Argentina Biol.* 6: 653-663.

—. 1931. Nouvelle mucedinacée parasite de l'homme, *C. R. Soc. Biol.* 106: 386-388.

—. 1933. Onycomycose par Cephalosporium spinosum n. sp., *C. R. Soc. Biol.* 113: 478-480.

Neves, Aroeira. See Aroeira Neves.

Ohue, Toshio. 1930. On a fungus found in the urine and the cerebrospinal fluid of a patient suffering from meningitis, *Sci. Rept. Tohoku Imp. Univ. Biol.* IV, 5: 117-132, *3 pls.*

Oláh, Daniel. 1933. Acrostalagmus cinnabarinus Corda gezüchtet aus einem klinisch als Trichophytia profunda erscheinenden Falle, *Derm. Woch.* 97: 1408-1410, *4 figs.*

Ota, Masao & Shûji Kawatsure. 1933. Zur Aetiologie der echten und falschen Blastomykosen, besonders der Gilchristschen Krankheit, *Arch. Derm. Syphilis* 169: 149-172, *11 figs.*

Parreiras Horta, P. 1919. Mycose do homem devido ao Fusariopsis Derriena, *Tribuna Med.* 25: 253-256.

—. 1919. Sobre uma nova mycose humana, *Brasil Med.* 33: 395.

Pedroso, Alex. & J. M. Gomes. 1920. Sobre quatro casos de dermatite verrucosa produzida pela Phialophora verrucosa, *Annaes Paulistas Med. Cirurg.* 11: 53-61, *Pls. 1-5.*

—. 1920. Quatro casos de dermatite verrucosa produzida pela Phialophora verrucosa, *Bull. Soc. Med. Cirurg. São Paulo* 3: 254.

Pepere, Alberto. 1913. Micetoma a grani neri del piede, *Lo Sperimentale* 67: [*Suppl. Atti dell' VIII Riunione, Soc. Ital. Patol.*] 213-217.

—. 1914. Sul fungo parassita di "un micetoma a grani neri" del piede (Carter) nostrano, *Lo Sperimentale* 68: 531-608, *Pls. 15-20.*

*—. 1914. Monosporosi alba e monosporosi nigra, *Soc. fra i Cultori di Sci. Med. e Nat. in Cagliari.*

Pollacci, Gino. 1921. Miceti del corpo umano e degli animali, *Atti Ist. Bot. R. Univ. Pavia* III, 18: 123-131, *Pls. 30, 31.*

—. 1922. Miceti del corpo umano e degli animali. II. Contributo botanico allo studio delle dermatomicosi, *Riv. Biol.* 4: 313-328, *2 pls.*

—. 1923. Miceti del corpo umano e degli animali nota terza. Due nuovi ifomiceti parassiti Acremoniella Perinii n. sp. Haplographium DeBellae-Marengoi Pollacci var. equinum n. var., *Riv. Biol.* 5: 358-367, *3 figs.*

Pozojewa, N. G. 1930. Ein Fall von Chromoblastomykose, *Derm. Woch.* 90: 615-617, *3 figs.*

Pribram, Ernst. 1930. Ringworm of the scalp caused by Alternaria tenuis Nees, *Jour. Infect. Dis.* 47: 11-15, *3 figs.*

Radaeli, Francesco. 1911. Micosi del piede da Monosporium apiospermum, *Lo Sperimentale* 65: 383-414, *Pls. 10, 11, Fig. 1.*

—. 1911. Caso singolare di alterazione cutanea e profunda di natura probabilmente micotica in un piede, *Giorn. Ital. Mal. Ven. Pelle* 52: 109-116.

—. 1914. Sulla Monosporosi a proposito di una nota di rettifica e di rivendicazione, *Lo Sperimentale* 68: 286-304.

Rebaudi, Ulisse & G. B. Podestà. 1922. Su una dermatosi, a tipo infiltroulceratico di verosimile origine penicillare, *Giorn. Ital. Mal. Ven. Pelle* 63: 871-883, *1 pl.*

Roger, H., Antoine Sartory & P. J. Ménard. 1912. Première note sur une nouvelle Mycose, *C. R. Soc. Biol.* 73: 5-7.

—. 1914. Une nouvelle mycose humaine, la chalarose, *Presse Méd.* 22: 141-143, *2 figs.*

*Sakai, W. & F. Ohue. 1927. Preliminary note on a meningitis-like disease caused by Alternaria sp. (Japanese), *Zeitschr. f. Diagnose u. Therapie* 14: 8.

Sartory, Antoine. 1921. Étude d'un champignon nouveau appartenant au genre Oospora (tribu des Solidae de Guéguen), *C. R. Soc. Biol.* 84: 939-941.

Serra, G. M. 1929. Un caso di cheratomicosi da un micete non isolato finora dall'occhio. Osservazione clinica, studio batteriologico ed istopatologico, *L'Ateneo Parmense* 1: 549-580, *8 pls.*

Smith, E. C. 1931. Two cases of dermatitis due to a species of Hormodendrum, *Trans. Roy. Soc. Trop. Med. Hyg.* 24: 461-464, *Pls. 1-3.*

Spillmann, L. & Louis Jannin. 1913. Mycose trichophytoïde due au Corethropsis hominis, *Bull. Soc. Franç. Derm. Syphiligr.* 24: 227, 228.

—. 1913. Un cas de mycose trichophytoïde due au Corethropsis hominis, *Rev. Méd. de l'Est* 45: 458.

Tarozzi, Giulio. 1913. Sui caratteri dello sviluppo nei tessuti del Monosporium apiospermum, *Atti Riunione Soc. Ital. Patol.* 8: 217-220 [issued with *Sperimentale* 67].

—. 1914. A proposito di una nuova malattia dell'uomo, la monosporosi, registrata in un trattato di parasitologia. Nota di rettifica e di rivendicazione, *Lo Sperimentale* 68: 255-285.

*Tarozzi, Giulio & Barbanti. 1915. Actinomicosi e Monosporosi. Modena.

Terra, Fernando, Margarinos Torres, Olympio da Fonseca filho & A. E. de Arêa Leão. 1922. Novo typo de dermatite verrucosa, mycose por Acrotheca com associação de leishmanosa, *Brasil Med.* 37: 363-368, *7 figs.*

Torres, Margarinos. See Margarinos Torres.

Tschernjawski, Johann. See Cherniavski, Ivan.

Vignolo-Lutati, Carlos. 1913. Ueber eine neue Mykosis (Acauliosis), *Arch. Derm. Syphilis* 118: 681.

Vilao-Boas Neto. 1933. Mycose des ongles et epidermophyton nigricans, *Ann. Derm. Syphiligr.* VII, 4: 526-536, *10 figs.*

Vuillemin, Paul [i.e. Jean Paul]. 1910. Les conidiosporés, *Bull. Soc. Sci. Nancy* III, 11: 129-172, *Pls. 1-5.*

—. 1910. Matériaux pour une classification rationelle des Fungi Imperfecti, *C. R. Acad. Sci.* 150: 882-884.

—. 1912. Sur une nouvelle espèce de Tilachlidium et les affinités de ce genre, *Bull. Soc. Myc. France* 28: 113-120, *Pl. 6.*

—. 1912. Sur un champignon parasite de l'homme Glenospora Graphii (Siebenmann), *C. R. Acad. Sci.* 54: 141-143.

—. 1929. Mycoses de l'épiderme, *C. R. Acad. Sci.* 189: 405-407.

—. 1930. Une nouvelle espèce de Corethropsis, C. Puntonii Vuill., provenent de l'homme, *C. R. Acad. Sci.* 190: 1334, 1335, *1 fig.*

Wahl, H. R. & R. L. Haden. 1924. Unusual organism (Alternaria sp.) occurring in chronic pulmonary disease. Preliminary note, *Jour. Am. Med. Assn.* 82: 1924, 1925, *4 figs.*

Wicherkiewicz, B. 1900. Ueber eine Schimmelpilzerkrankung der Hornhaut, *Arch. Augenheilk.* 40: 361-367.

Wilson, Sidney J., Sim Hulsey & Fred. D. Weidman. 1933. Chromoblastomycosis in Texas, *Arch. Derm. Syphilol.* 27: 107-122, *5 figs.*

Wright, R. E. 1929. Hypopyon ulcer of the cornea due to Glenospora graphii, *Brit. Jour. Ophthalmology* 13: 496-498.

INDEX

A

- Abdomen, 228, 431, 437, 712, 752
- Abscess, 168, 175, 208, 209, 228, 242, 311, 318, 320-323, 336, 337, 536, 715, 726, 795, 801, 855
  - brain, 749, 750
  - bronchial, 749
  - cervical, 632
  - chest, 760
  - cold, 183
  - cutaneous, 340
  - iliac, 733
  - jaw, 734, 755, 761
  - lung, 218, 236
  - subcutaneous, 651, 679, 722, 762
  - subepidermal, 631
  - tongue, 760
  - tonsillar, 755
  - tooth, 734
- *Absidia* Tiegh., 98, 99, 101, 108, 110, 111, 115, 326
  - key, 112
  - *capillata* Tiegh., 111
  - *cornealis* V. Cavara & Sacc., 114
  - *corymbifera* (Cohn) Sacc. & Trotter, 110, 112, 113, 117
  - *dubia* Bainier, 113
  - *glauca* Hagem,* 106
  - *italiana* (Cost. & Perin) Dodge, 112
  - *Lichtheimi* Lendner, 112
  - *Orchidis* (Vuill.) Hagem, 107
  - *ramosa* (Lindt) Lendner, 111-113
    - var. *Rasti* Lendner, 113
    - var. *Zurcheri* Lendner, 113
  - *Regnieri* (Lucet & Cost.) Lendner, 112, 113
  - *Truchisi* (Lucet & Cost.) Lendner,* 99, 112, 114
- *Acaulium* Sopp, 643
  - *Vignoli-Lutatii* Matr., 650
- Acervuli, 19
- *Achorion* Remak, 443, 458, 461, 466, 467, 476, 494, 528, 533, 551, 653
  - key to species, 552, 553
  - *africana* Dodge, 553, 560
  - *akromegalicum* Neebe & Unna, 558
  - *annulosum* Caz., 553, 561
  - *Arloini* Busquet, 459, 495, 507, 556
  - *atacton* Unna, 558
  - *caninum* (Cost. & Sabrazès) Dodge, 553, 560
  - *cupressiforme* Aoki, 552, 557
  - *cysticum* Neebe & Unna, 558
  - *demergens* Neebe & Unna, 558
  - *dichroon* Unna, 558
  - *eurythrix* Neebe & Unna, 556
  - *formoseum* Hasegawa, 557
  - *gallinae* (Mégnin) Sab., 462, 468, 469, 552, 554

Achorion—Cont'd

  - *gypseum* Bodin, 430, 455, 458, 461, 466-468, 470, 471, 544, 552, 553
  - *keratophagus* Ercolani, 558
  - *moniliforme* Neebe & Unna, 558
  - *muris* (Gluge & d' Ukedem) Dodge, *454, 462, 468-471, 508, 552, 555
  - *niveum* Greco, 553, 560
  - *passerinum* Fischer, 553, 560
  - *Quinckeanum* Bodin, 556
  - *radians* Neebe & Unna, 558
  - *repens* Guéguen, 489
  - *Schoenleini* (Lebert) Remak, 156, 450, 462, 466, 469, 471, 474, 545, 552, 556-558
    - aleurospore, *454
    - closterospores, *453
    - effect on hair, *442
    - hyphal tips, *452
    - pedicillate chlamydospores, *452
    - var. mongolica (Hashimoto & Ota) Dodge, 559
  - *Serisei* Caz., 552, 554
  - *tarsiferon* Neebe & Unna, 558
  - *violaceum* Bloch, 552, 554
  - sp. Aoki, 557
  - sp. Draper, 555
  - sp. Mitchell & Robertson, 560
  - sp. Truffi, 519
- *Achorion (Bodinia) album* Guiart & Grig., 515
  - *ochraceum* Guiart & Grig., 521
  - *violaceum* Guiart & Grig., 554
- *Achorion (Endodermophyton) concentricum* Guiart & Grig., 490
  - *indicum* Guiart & Grig., 491
- *Achorion (Grubyella) ferrugineum* Guiart & Grig., 545
  - *Schoenleini* Guiart & Grig., 558
- Achromia, 677
- *Acladium* Link, 835, 836
  - *americanum* Ota, 684
  - *Castellanii* Pinoy, *836
    - aleurospores, *454
    - mycelium, *449
  - *conspersum* Link, *836
- Acne, 361
  - disseminata, 361
  - frontalis, 364
  - miliary sebaceous, 363
  - necrotica, 361, 364
  - rosacea, 361, 365
  - vulgaris, 361
- *Acremoniella* Sacc., 786, 798
  - *Berti* Poll., 643, 798
  - *olivaespora* Cif. & Ashford, 798
  - *Perinii* Poll., 798

---

*Indicates illustration.

Acremonium Link, 359, 786, 795
  alternatum Link, *796
  atrum Corda, 798
  kiliense Gruetz, 828
  Muthuoni Font. & Boucher, 795
  niveum Boucher, 796
  Potronii Vuill., *797
  verticillatum Link, 795
  sp. Ballagi, 829
Acrocylindrium Bon., 842
Acrostalagmus Corda, 842
Acrotheca Fuckel, 850
  Gei Fuckel, 850
  Pedrosoi Fonseca & Arêa Leão, 850
Acrotheciella Koord., 854
Acrothecium (subgenus) Corda, 854
Acrothecium Preuss, 854
  floccosum Harz, 482
  multisporum Preuss, 854
  nigrum Cif., 854, *855
  obovatum var. *subcapitulatum* Ashford & Cif., 855
Actinobacillus Brumpt, 705
Actinomyces Harz, 156, 229, 489, 669, 681, 694, 703-705, 761, 809
  description of genus, 706
  key to species, 706-711
  methods for study, 702, 703
  systematic position, 703-705
  actinoides (T. Smith) Bergey, 707, 716
  africanus (Pijper & Pullinger) Nann., 710, 754
  albus (Rossi-Doria) Gasperini, *699, 708, 725
  albus Tarozzi, 735
    var. *tossica* Rossi, 719
  americana (Chalm. & Christ.) Dodge, 707, 716
  anaerobies Plaut, 717
  appendicis (Chalm. & Christ.) Brumpt, 733
  asteroides (Eppinger) Gasperini, 710, 746, 750
    var. *serratus* Sart., Meyer & Meyer, 745
  aureus (DuBois Saint Severin) Lachner Sandoval, *701, 708, 732
  Avadi Dodge, 708, 729
  bahiensis (Pirajá da Silva) Brumpt, 709, 740
  Bellisari Dodge, 709, 744
  Berestneffi (Chalm. & Christ.) Sart. & Bailly, 710, 754
  bicolor Trolldenier, 710, 748
  Bolognesii-Chiurcoi (Vuill.) Dodge, 766
  bovis Harz, 706, 708, 730, 802
    albus Gasperini, 725
    farcinicus Gasperini, 746
    sulphureus Gasperini, 730
  brasiliensis (Lindenberg) Gomes, 710, 749
  bronchialis Sart., 711, 757
  Bruni Brumpt, 752
  buccalis (Roger, Bory & Sart.) Sart. & Bailly, 710, 755
  cameli (Mason) Sart. & Bailly, 762
  candidus Petruschky, 708, 725
  canis (Vachetta) Gasperini, 710, 748
  caprae (Silberschmid) Nann., 710, 748
  carneus (Rossi-Doria) Gasperini, 709, 741
Actinomyces—Cont'd
  Carougeaui (Goug.) Brumpt, 706, 711
  catarrhalis (Sart. & Bailly) Brumpt, 708, 733
  cati Gasperini, 762
  cerebriformis Namysłowski, 707, 719
  Chalmersi (Froilano de Mello & St. Antonio Fernandes) Dodge, 708, 734
  Christophersoni (Froilano de Mello & St. Antonio Fernandes) Dodge, 707, 723
  chromogenes β Gasperini, 725
  congolensis Brumpt, 809
  convolutus (Chalm. & Christ.) Brumpt, 709, 745
  cruoris (Macfie & Ingram) Brumpt, 710, 753
  cuniculi (Schmorl) Gasperini, 706, 712
  cylindraceus (Korte) Brumpt, 707, 716
  Dassonvillei (Liègard & Landrieu) Brumpt, 708, 727
  deBerardinis Namsłowski, 709, 746
  decussatus (Lang. & Chevallier) Brumpt, 711, 760
  dermatonomus Bull, 717, 719
  discofoliatus Gruter, 706, 714
  Donnae Dodge, 709, 745
  Dori (Beurmann & Gougerot) Brumpt, 762
  enteritidis (Pottien) Brumpt, 762
  equi (Chalm. & Christ.) Sart. & Bailly, 711, 758
  erysipeloides (Neum. & Lehm.) Lachner Sandoval, 762
  farcinicus (Trev.) Gasperini, 709, 746
  flava (Chester) Dodge, 710, 752
  Foersteri (Cohn) Gasperini, 706, 713
  Foulertoni (Chalm. & Christ.) Sart. & Bailly, 711, 760
  Freeri (Musgrave & Clegg) Bergey, 709, 742
  fuscus (Karwacki) Sart. & Bailly, 710, 757
  Garteni Brumpt, 708, 726
  gedanensis (Scheele & Petruschky) Brumpt, 708, 733
  Genesii (Fróes) Dodge, 761
  Gibsoni Dodge, 707, 722
  goensis (Froilano de Mello & St. Antonio Fernandes) Dodge, 707, 723
  griseus Krainsky, *699
  Gruberi Terni, 746, 763
  Guegueni (Ota) Brumpt, 707, 722
  gypsoides Henrici & Gardner, 707, 742
  Hofmanni Gruber, 709, 742
  invulnerabilis (Acosta & Grande Rossi) Dodge, 707, 724
  Israeli (Kruse) Dodge, 706, 714
  japonica Caminiti, 709, 746
  Jollyi (Vuill.) Brumpt, 709, 742
  keratolytica Acton & McGuire, 708, 736
  Krausei (Chester) Brumpt, 710, 755
  Lanfranchii Sani, 731
  Lasserrei (Verdun) Brumpt, 763
  lavendulae Waksman & Curtis, *702
  Leishmani (Chalm. & Christ.) Sart. & Bailly, 709, 740
  Levyi Dodge, 708, 730
  lingualis (Weibel) Sart. & Bailly, 709, 743

Actinomyces—Cont'd
  liquefaciens (Hesse) Brumpt, 708, 731
  londinensis Brumpt, 711, 760
  luteolus (Foulerton & Jones) Brumpt, 708, 732
  luteus Brumpt, 763
  macrodipodidarum (Fox) Dodge, 709, 747
  Madurae (Vincent) Lachner Sandoval, 709, 739
  Matruchoti (Mendel) Nann., 708, 734
  mexicanus Boyd & Crutchfield, 707, 721
  micetomae Greco, 709, 738
  mineaceus (Kruse) Lachner Sandoval, 707, 718
  minimus (LeCalve & Malherbe) Dodge, 708, 728
  minutissimus (Burchard) Brumpt, 709, 741
  mordoré Thiry, 729
  Muris-ratti (Schottmüller) Nann., 711, 759
  musculorum Hertwig, 706, 711
  necrophorus (Flügge) Lehm. & Neum., 706, 713
  Neschczadimenki (Chalm. & Christ.) Dodge, 706, 712
  Nicollei (Delanoë) Nann., 708, 726
  niger (Rossi-Doria) Brumpt, 709, 743
  odorifer (Rullmann) Lachner Sandoval, 763
  panginensis (Froilano de Mello & St. Antonio Fernandes) Dodge, 707, 718
  Pelletieri (Laveran) Brumpt, 764
  phenotolerans Werkman, 709, 744
  Pijperi (Cast. & Chalm.) Sart. & Bailly, 710, 755
  Pinoyi (Froilano de Mello & St. Antonio Fernandes) Dodge, 707, 723
  plurichromogenus (Caminiti) Dodge, 708, 737
  pluricolor Gasperini, 763
  Ponceti Brumpt, 710, 754
  pretorianus (Pijper & Pullinger) Nann., 709, 747
  purpureus Cavara, 764
  pseudotuberculosae Brumpt, 764
  pseudotuberculosis Keller, 764
  pulmonalis (Roger, Sart. & Bory) Sart. & Bailly, 711, 758, 764
  Putorii (Dick & Tunnicliff) Dodge, 759
  putridogenes (Vezspremi) Nann., 761
  pyogenes (Chalm. & Christ.) Dodge, 707, 723
  radiatus Namysłowski, 708, 729
  Ribeyroi Dodge, 708, 735
  Rivierei (Verdun) Brumpt, 707, 721
  Rodellae Dodge, 708, 734
  Rogersii Brumpt, 764
  roseus Namysłowski, 707, 725
  ruber Krainsky, 718
  ruber Sart. & Bailly, 718
  rubidaureus Lachner Sandoval, 708, 729
  Sabrazès et Rivieri Berestnev, 721
  Salvati Lang., 733
  Sanfelicei (Red.) Nann., 710, 751
  Sartoryi Dodge, 710, 756
  scabies (Thaxter) Güssow, 701, *704
  serratus (Sart., Meyer & Meyer) Dodge, 709, 745

Actinomyces—Cont'd
  Silberschmidti (Chalm. & Christ.) Dodge, 706, 711
  somaliensis Brumpt, 765
  Sommeri Greco, 709, 739
  Spitzi (Lignières & Spitz) Dodge, 710, 752
  spumalis (Sart.) Dodge, 710, 751
  Taraxeri-cepapi (Schottmüller) Dodge, 711, 759
  Tarozzii (Miescher) Dodge, 708, 735
  tenuis (Cast.) Dodge, 706, 715
  Thibiergei (Ravaut & Pinoy) Greco, 706, 715
  Thiryi Sart. & Bailly, 729
  Thjottae Dodge, 706, 713
  tossicus (Rossi) Dodge, 707, 719
  transvalensis (Pijper & Pullinger) Nann., 710, 756
  urethritidis (Roсček) Brumpt, 765
  valvulae (Froilano de Mello) Nann., 710, 757
  verrucosus (Miescher) Adler, 709, 738
  viridis (Lombardo Pellegrino) Dodge, 707, 717
  sp. Bruns, 752
  sp. Butterfield, 717
  sp. I Drechsler, 700
    II Drechsler, *696, 697, 700
    V Drechsler, 699
    VI Drechsler, 700
    XIII Drechsler, 696
    XVIII Drechsler, *698, *700
  sp. Levy, 730
  sp. Löwenstein, 725
  sp. Ping-Ting-Huang, 766
  sp. Sart. & Sart., 755
  sp. Ørskov, 705
Actinomycetales, 667
  general discussion, 694
  morphology, 695
Actinomycosis dyshidrosiformis, 766
Actonia Dodge, 145, 155
  tropicalis (Acton) Dodge, 145, 146
Adamson's method for staining hair and scrapings, 69
Adelphogamy, 23
Adenitis, 355
  inguinal, 678, 726
Adenomyces Cruzi Dias, 860
African squirrel, bite of, 759
Agar, Benedek's, 53
  carrot, 186
  Currie's, 54
  Falchi's, 54
  Farley's, 53
  Fulmer & Grimes', 54
  Goldschmidt's, 52
  Gorodkova's, 306
  Grigorakis', 53
  Grigorakis' spleen, 53
  Gruetz, 52
  kojiserum, 248
  Macleod's, 53
  Norris', 54
  Pollacci's, 52, 53

Agar—Cont'd
  Sabouraud's conservation, 51, 52
    glucose, 186
    test, 52
Aleurisma Link, 463, 786
  key to species, 787
  albiciscans (Nieuwenhuis) Dodge, 440, 787, 788
  apiospermum Maire, 838
  Arloingi Vuill., 507
  benigna (Magalhães) Vuill., 787, 789
  breve (Cast.) Dodge, 790
  dermatitidis (Agostini) Dodge, 787, 789
  Guilliermondi Grig., 459, 495, 508
  lugdunense Vuill., 787, 789
  metaeuropeum (Cast.) Dodge, 790
  metamericanum (Cast.) Dodge, 790
  salmoneum Vuill., 787, 788
  sporulosum Link, 787
  tulanense Ota & Kawatsure, 793, 841
  Vuillemini Grig., 787, 790
Aleurocloster Ota & Lang. (sect.), 463
Aleurophora Magalhães, 786, 787
  benigna Magalhães, 789
Aleurospores in Trichophytoneae, *454
Aleurosporia Grig., 463
  acuminata Grig., 534
  denticulata Grig., 498
  effracta Grig., 532
  plicatilis Grig., 530
  radians Grig., 497
  rosacea Grig., 504, 510
  velvetica Grig., 550
Allantospora onychophila Vuill., 825
Allergy in Trichophytoneae, 474-476
Allescheria Sacc. & Syd., 652
  Boydii Shear, 652, 829, 858
Alnus L., 160
Alopecia, 518, 534
  seborrheic, 361
Alternaria Nees, 676, 856
  tenuis Nees, 856, 857
  sp., *666
Alternarieae, 856
Amann's lactophenol solution, 67
    modifications of, 67
Amauroascus Schröt., 429
  verrucosus (Eidam) Schröt., *426
Amphimixis, 21
Anaeromyces bronchitica Chalm., Doug. & Thomson, 761
Anemia, 153
Angina, 263, 311, 344
Anginous exudate, 729
Antheridium, 22, 121
Antromyces Fres., 858
Antromycopsis Pat. & Trab., 858
Aphanoascus cinnabarinus Zukal, *609
Aphthae alba, 274
  infantum, 274
  lactamen, 274
  lactantium, 274
Apogamy, 23
Apomixis, 23
Appendicitis, 733
Appressoria, 18
Arachniotus Schröt., 429
  candidus (Eidam) Schröt., 425
Arbuscules, 194
Arm, 227, 233, 242, 319, 499, 506, 514, 637, 674, 677, 735, 788, 795, 832, 857
Armillaria mellea (Vahl. ex Fr.) Quél., 139
Armpit (*see* Axilla)
Arracacha esculenta DC., 341
Arthrineae, 667
Arthrobotrys Corda, 851
  superba Corda, *852
Arthrobotryum Ces., 858
Arthrospores, 19
  in Trichophytoneae, *451
Arthrosporia Grig., 463, 552
  alba Grig., 515
  Gougeroti Grig., 559
  indica Grig., 491
  ochracea Grig., 521
  Schoenleinii Grig., 558
  tropicalis Grig., 492
  violacea Grig., 523
Arthrosporium Sacc., 858
Asci, 20, 121
Ascites, 245
Ascogenous hyphae, 122
Ascogonium, 22, 121
Ascoidea Bref., 145, 304
  rubescens Bref., 137
Ascoideaceae, 126, 127, 137, 146, 147
Ascomycetes, 24, 25, 121-125, 146
Ascospore detection, 61, 62
Ascospores, 20, 121, *129
  Aspergillus, *620
Ascostroma, 125
Asepsis in the cultivation of organisms, 48
Ashbya Guill., 136
  Gossypii (Ashby & Nowell) Guill., *130
Ashbyaceae, 126, 128
Aspergillaceae, 425, 665, 667
  general discussion, 608, 609
  key to genera, 621
  morphology of, 610-620
Aspergillus Mich., 183, 432, 489, 622, 639, 681, 826
  Amstelodami (Mangin) Thom & Church, 623, 630, *631
  ascospores, *620
  description, 621, 622
  key to pathogenic species, 623, 624
  pathogenicity, 622
    var. *alophote* Duché, 630
  atropurpureus Zimmermann, 625
  aviarius Peck, 634
  Bouffardi Brumpt, 685
  Brodeni (Mattlet) Dodge, 624, 635
    var. *Vancampenhouti* (Mattlet) Dodge, 624, 636
  Bronchialis Blumentritt, 624, 633
  carbonarius seu ater Meis & Parascandalo, 679
  cinnamominus (Weiss) Dodge, 623, 627
  concentricus Cast., 490
  cyaneus (Mattlet) Dodge, 624, 636
  Dessyi Speg., 834
  diplocystis (Sart., Sart., Hufschmidt & Meyer) Dodge, 625
  Fischeri Wehmer, ascospore, *620

Aspergillus—Cont'd
  flavescens Wreden, 623, 624
  flavus Link, 625, 639
  Fontoynonti Guéguen, 624, 632
  fumigatoides Bainier & Sart., 624, 633
  fumigatus Bovo, 685
  fumigatus Fres., 624, 625, 633, 634
    var. *alpha* Sion & Alexandrescu, 634
    var. *minimus* Sart., 635
  fuscus Bainier, 625
  giganteus (Mattlet) Dodge, 269, 623, 629
  glaucoides Spring, 634
  glaucus Hassenstein, 625, 793
  Gratioti Sart., 623, 627
  Greconis Dodge, 623, 624
  herbariorum (Wiggers) Fischer, ascospore, *620
  Hortai (Lang.) Dodge, 623, 628
  Jeanselmei Ota, 624, *638
  lepidophyton Pinoy, 490
  luteus (Tieghem) Dodge, 623, 625
  Macfiei Dodge, 623, 629
  malignus (Lindt) Thom & Church, 624, 632
  Mencieri Sart. & Flamant, 623, 630
  montevidensis Tal. & Mack., 623, 631
  mycetomi Villabruzzi & Gelonesi, 684
  nidulans (Eidam) Lindt, *617, 622, 624, 625, 636
      ascospore, *620
    var. *Cesarii* Pinoy & Masson, 637
    var. *Nicollei* Pinoy, 624, 637
  niger Tiegh. 622, 623, 628, 641
  nigrescens Robin, 634
  nigricans Wreden, 628
  ochraceus Wilhelm, 624
  Oryzae (Ahlb.) Cohn, 248
  Phoenicis (Corda) Thom & Church, 623, 628
  pseudonidulans Vuill., ascospore, *620
  pulmonum-hominis Welcker, 634
  ramosus Hallier, 634
  repens (Corda) Sacc., 183
    ascospore, *620
  ruber (Spieckermann & Bremen) Thom & Church, 623, 630
  subfuscus Johan-Olsen & Gade, 623, 627
  Tamarii Kita, 623, 626
  terreus Thom, 628
  tokelau Wehmer, 490
  tunetanus (Lang.) Dodge, 624, 635
  unguis (Weill & Gaudin) Dodge, 624, 637
  virido-griseus Cost. & Lucet, 624, 633
  sp. Sart. & Flamant, 630
Asporomyces Chaborski, 325, 356
  asporus Chaborski, 356
  Mugera (Mattl.) Dodge, 356
Ass, lung, 637
  lymphatics, 169
  skin, 169, 526
  tear ducts, 251
Asthma, 176
Ateleothylax Chalm. & Marshall, 429
  Currii (Chalm. & Marshall) Ota & Lang., 431, 495, 529
  Viannai (Froilano de Mello) Dodge, 431, 479, 494
Atelosaccharomyces Beurm. & Goug., 325, 342
  key to species, 342, 343
  Breweri Verdun, 337
  Busse-Buschki Beurm. & Goug., 343
  Catanei Dodge, 342, 343
  clericus Dodge, 343, 345
  Conori Dodge, 343, 344
  Gottii (Neveu-Lemaire) Froilano de Mello, 346
  guttulatus Beurm. & Goug., 317
  Harteri Beurm. & Goug., 178
  hominis (Vuill.) Froilano de Mello, 244, 282, 309, 342, 343
  laryngitidis (Sart., Petges & Claqué) Dodge, 343, 344
  membranogenes (Steinhaus) Dodge, 343, 344
  paratropicalis Froilano de Mello & Gonzaga Fernandes, 264
  pseudotropicalis Froilano de Mello & Gonzaga Fernandes, 259
  pyogenes (Mattl.) Dodge, 268, 343, 345
  tropicalis Froilano de Mello & Gonzaga Fernandes, 258
  sp. Beurm. & Goug., 346
  sp. Duval & Laederich, 309
Atractium Link, 858
Atrichophyton Cast. & Chalm., 463
  albiciscans Cast. & Chalm., 788
  Blanchardi Cast. & Chalm., 536
  ceylonense Cast. & Chalm., 488
  Macfadyeni Cast., 369
  Viannai Cast. & Chalm., 431
Autogamy, 23
Automixis, 22
Axilla, 174, 278, 286, 289, 319, 353, 651
Azygospore, 106

B

Báanêcêdútú, 493
Bachmann's method of staining hair and scrapings, 69
Bacillus, acne, 360
  bottle, 360
  du farcin Nocard, 746
Bacillus actinoides Smith, 716
  megatherium Bary, 308
  necrophorus Flügge, 713
  prodigiosus Flügge, 348
Back, 507
Bacteria, 24
Bacterium actinocladothrix Afanassiev, 730
  coli (Escherich) Lehm. & Neum., 259
Baldness, 361, 363-365
Bargellinia Borzi, 164, 165, 182, 324
  monospora Borzi, 182
Basidia, 20
Basidiobolus hominis Casagrandi, 98
Basidiomycetes, 20, 24, 25
Basidiospores, 20
Beard, 210, 312, 448, 498, 501, 504, 508, 510, 514, 523, 526, 529-532, 544 (*see also* Sycosis)
Benda's fluid for fixing fungi, 71
Benedek's medium, 53
Black tongue (*see* Lingua nigra)
Blackheads, 361
Bladder, 236

Blakeslea trispora Thaxter, *102
Blastocystis enterocola, 262
Blastodendrion Ota, 191, 194, 207, 208, 282, 283
  key to species, 283
  nomenclature, 202, 203
  Arzti Ota, 288
  Braulti Lang. & Tal., 277
  Carbonei Cif. & Red., 354
  cutaneum (Ota) Dodge, 283, 287
    var. *Fujii* Dodge, 287
  elongatum Mattl., 283, 284
  erectum Camargo, 289
  Favrei (Ota) Dodge, 283, 286
  gifuense (Taniguchi) Dodge, 283, 288
  globosum Zach, 234
  gracile Zach, 234
  intermedium Cif. & Ashford, 188, *189, 283, *284
  irritans A Mattl., 268
  irritans B Mattl., 269
  Kayongosi Mattl., 257, 283, 285
  Krausi Ota, 202, 283
  oosporoides Zach, 266
  Pinoyi (Cast.) Lang. & Tal., 283, 285, *286
Blastomicete Corselli & Frisco, 338
Blastomyces Cost. & Rolland, 786
  dermatitidis Gilchrist & Stokes, 165, 166, 168
  Hessleris Rettger, 242
  Hildegaard Sasakawa, 314
  (Leopold) Sasakawa, 313
  lithogenes Sasakawa, 331
  neoformans Arzt., 330
  Tonkini Legendre, 357
  vitro simile degenerans Roncali, 339
    sp. Brewer & Wood, 337
    sp. Escomel, 341
    sp. Rudolf, 849
Blastomycoides Cast., 165
  dermatitidis Cast., 168
  immitis Cast., 149, 166, 219
  lanuginosus Cast., 792, 793
  tulanensis Cast., 793, 841
Blastomycosis, 219, 228, 297, 309
  brain, 332
  generalized, 168, 178, 299
  Gilchrist type, 315
  interdigital, 288
  meningeal, 333
  of central nervous system, 299
  pulmonary, 220, 254
  skin, 334
  systemic, 168, 178, 299
Blastospores, 17
  types of, *192
Blastotrichum Corda, 463, 859
  floccosum Berlese & Voglino, 482
Blood, 210, 642, 753
Bodinia Ota & Lang., 435, 463, 464, 512
  abissinica Agostini, 517
  annulosa Ota & Lang., 561
  balcanea Ota & Lang., 518
  fuliginea Ogata, 526
  glabra Ota & Lang., 522
  spadicea Poll. & Nann., 524
  spadix Katoh, 524
Bodinia—Cont'd
  violacea Brumpt, 554
  violacea Ota & Lang., 523
Boils, blind, 511
Bone, 156, 183, 343, 745, 754, 805
Botanical nomenclature, rules of, 75-96
Botryosporium Corda, 824
Botrytideae, 667, 835
Botrytis Mich., 835
  pyogenes Fayod, 297
  sp. Auche & Le Dantec, 297
Bottle bacillus, 360
Brachysporium Sacc., 854
Brain, 332, 749
  medium, Hibler's, 53
Branches, copulation, 22
Branching, dichotomous, 695-702
Breast, 282
Brevistreptothrix Israeli Lignières, 714
Briosia Cav., 182, 858
Bronchi, 146, 224, 633, 651, 722, 749
Bronchiectasis, 221
Bronchioles, 146
Bronchitis, 143, 176, 219, 220, 229, 231, 240, 258, 296, 297, 321, 350, 713, 755
  chronic, 218, 224, 225, 255, 353, 636, 741, 756
Bronchomycosis, 112, 175, 204, 253, 256, 257, 261, 264, 267, 285, 629, 635, 636, 810
Bronchopneumonia, 146, 181, 349, 753
Broussonetia papyrifera Vent., 288
Bubonic plague, 742
Bulbils, 19
Buttocks, 277, 323, 485-488, 533, 833

C

Cacumisporium Preuss, 854
Calamus, 327
Calcarisporium Preuss, 842
Calf, diphtheria, 713
  pneumonia, 716
  skin, 515
Camel, pseudotuberculosis of, 762
Camptoum Link, 850
Canary, skin, 560
Cancer, 331, 335
Candida Berkh., 206-208, 216, 229, *230, *271, 273
  key to species, 229
  nomenclature, 201, 202
  acraensis Basgal, 264
  alba Almeida, 240
  albicans Basgal, 274
  aldoi Cast. & Jacono, 292
  Balzeri Almeida, 212
  bethaliensis (Pijper) Dodge, 229, 231
  Bonordeni Basgal, 270
  brasiliensis Basgal, 157
  bronchialis Basgal, 254
  butantanensis Lang. & Tal., 244
  Chalmersi Basgal, 257
  enterica Almeida, 264
  Favrei Almeida, 286
  insolita Basgal, 258
  Kochii Basgal, 272

- *Candida*—Cont'd
  - *Krusei* (Cast.) Basgal, 229, 231, *232
  - *metalondinensis* Basgal, 256
  - *mortifera* Red., 203, 293, 295
  - *nitida* Basgal, 261
  - *nivea* Basgal, 256
  - *parapsilosis* Camargo, 294
  - *paratropicalis* Basgal, 264
  - *Perieri* Almeida, 213
  - *pinoysimilis* Cast., 297
  - *pseudotropicalis* Basgal, 259
  - *psilosis* Almeida, 279
  - *pulmonalis* Almeida, 298
  - *pulmonalis* Basgal, 255
  - *rhoi* (Cast. & Chalm.) Almeida, 229, 233
  - *rosea* Almeida, 293
  - *rotundata* Basgal, 220
  - *tropicalis* Basgal, 258
  - *tumefaciens* (Poll. & Nann.) Dodge, 229, 232
  - *urinae* Dodge, 229, 230
  - *vulgaris* Berkh., 229
  - *zeylanica* Basgal, 241
- *Candida* Lang. & Tal., 270
- *Caraipa silvatica* B. Rodr., 472
- Caraté, 676
  - black, 676
- *Caraté noir* Montoya y Florez, 676
- Carbon requirements of fungi, 33
- Carcinoma, 223, 313
- Carrot agar, 186
- Caryogamy, 23
- *Castellania* Dodge, 206, 208, 246, 248
  - key to species, 246-248
  - *accraensis* (Macfie & Ingram) Dodge, 264
  - *aegyptiaca* (Khouri) Dodge, 247, 254
  - *africana* (Macfie) Dodge, 248, 262
  - *alba* (Cast. & Chalm.) Dodge, 248, 262
  - *balcanica* (Cast. & Chalm.) Dodge, 246, 249
  - *bronchialis* (Cast.) Dodge, 247, 254
  - *burgessi* (Cast.) Dodge, 247, 255
  - *Castellanii* (Re) Dodge, 246, 250
  - *Chalmersi* (Cast.) Dodge, 247, 257
  - *Copellii* (Neveu-Lemaire) Dodge, 252
  - *decolorans* (Cast. & Low) Dodge, 247, 253
  - *dissocians* (Mattl.) Dodge, 246, 250
  - *enterica* (Cast.) Dodge, 248, 264
  - *epidermica* (Cif. & Alfonseca) Dodge, 246, 251
  - *faecalis* (Cast.) Dodge, 247, 254, 280
  - *Guilliermondi* (Cast.) Dodge, 247, 257
  - *Hashimotoi* Dodge, 248, 260
  - *hominis* (Cast. & Chalm.) Dodge, 246, 250
  - *insolita* (Cast.) Dodge, 247, 258
  - *intestinalis* (Cast.) Dodge, 247, 253
  - *Kartulisi* (Cast.) Dodge, 248, 260
  - *Lesieuri* (Beauverie) Dodge, 246, 249
  - *linguae-pilosae* (Lucet) Dodge, 248, 260
  - *londinensis* (Cast. & Chalm.) Dodge, 247, 252
  - *Lustigi* (Cast. & Chalm.) Dodge, 247, 258
  - *macedoniensis* (Cast. & Chalm.) Dodge, 259
  - *macedoniensoides* (Cast. & Tayl.) Dodge, 247, 253
  - *mannitofermentans* (Cast.) Dodge, 247, 255
- *Castellania*—Cont'd
  - *metalondinensis* (Cast. & Chalm.) Dodge, 256
  - *metatropicalis* (Cast. & Chalm.) Dodge, 247, 258
  - *Metchnikoffi* (Cast.) Dodge, 246, 250
  - *Mirandei* (Velu) Dodge, 247, 251
  - *Muhira* (Mattl.) Dodge, 247, 257
  - *Nabarroi* (Cast. & Chalm.) Dodge, 247, 253
  - *Negrii* (Cast.) Dodge, 247, 253
  - *nitida* (Cast.) Dodge, 248, 261
  - *nivea* (Cast.) Dodge, 247, 256, 264
  - *Nogami* Dodge, 246, 248
  - *Orticoni* Dodge, 248, 261
  - *parabalcanica* (Cast. & Chalm.) Dodge, 246, 249
  - *parakrusei* (Cast. & Chalm.) Dodge, 248, 261
  - *paratropicalis* (Cast.) Dodge, 248, 264
  - *platensis* (Peruchena) Dodge, 248, 262
  - *pseudoguillermondi* (Cast. & Chalm.) Dodge, 256
  - *pseudolondinensis* (Cast. & Chalm.) Dodge, 247, 255
  - *pseudolondinoides* (Cast. & Chalm.) Dodge, 247, 255
  - *pseudometalondinensis* (Cast. & Chalm.) Dodge, 247, 255
  - *pseudotropicalis* (Cast.) Dodge, 248, 259
  - *pulmonalis* (Cast.) Dodge, 247, 255
  - *Richmondi* (Shaw) Dodge, 247, 256
  - *Rogerii* (Sart. & Demanche) Dodge, 247, 254
  - *tropicalis* (Cast.) Dodge, 247, 258
  - *unguium* (Bourgeois) Dodge, 246, 248
  - *Valeriana* Dodge, 248, 259
- Castellani's carbolfuchsin paint, 472
- Cat, 119, 542
  - favus, 430
  - skin, 553
- *Catenularia* Grove, 843
  - *atra* (Corda) Lindau, 843
  - *fuliginea* Saito, 843
- Cattle, neat (*see also* Calf)
  - carcinoma, 332
  - endocarditis, 757
  - farcy, 746
  - ganglionar actinomycosis, 731
  - glandular actinomycosis, 731
  - jaw, 731, 752
  - lymphatic ganglia, 332
  - skin 515-517, 519, 520, 526, 720
- Cell types, Shrewsbury's, *193
- Cephalosporieae, 667
  - characters, 823
  - key to genera, 824
- *Cephalosporium* Corda, 823, 824
  - description of genus, 826
  - key to species, 826, 827
  - *Acremonium* Corda, 826
  - *Acremonium* Poll. & Nann., 828
  - *asteroides griseum Gruetzii* Benedek, 828
  - *Bogolepoffi* (Vuill.) Dodge, 827, 830, 858
  - *Boydii* Shear, 652, 826, 829
  - *Doukourei* Boucher, 826, 827
  - *griseum* Goug., 826, 828

Cephalosporium—Cont'd
  kiliense (Grütz) Hartmann, 826, 828, 829
  niveolanosum Benedek, 826, 829
  pseudofermentum Cif., 826, 828
  rubrobrunneum Nann., 827, 829
  rubrobrunneum cerebriforme Hartmanni Benedek, 829
  Serrae Maffei, 827, 831
  spinosum Negroni, 827, 830
  Stuehmeri Schmidt & Beyma, 827, 829
  sp. Negroni, 830
  sp. Serra, 831
Ceratocladium Corda, 858
Cercosporella vexans Massee, 505
Cereal, 744
Cerebellum, 167
Cerebrospinal fluid, 299
Cervix, 632
Chaetocladium Fres., 104, 105
Chaetocladium Brefeldii Tiegh. & Lemonnier, 104
  Jonesii (Berk. & Br.) Fres., 104
Chaetostylum Fresenii Tiegh. & Lemonnier, 104
Chalara Corda, 795, 822
Chalara fusidioides Corda, 822, *823
  pyogenes Roger, Sart. & Ménard, 822
Chalareae, 667
  characters, 822
  key to genera, 822
Chalmers & Marshall's method of staining hair and scrapings, 69
Chaluni, 736
Chara Vaill. 327
Cheeks, 341
Cheilitis, exfoliative, 361
Chemotropism, 40
Chest, 349, 674, 735, 760, 801
Chimbêrê, 493
Chin, 486, 677
Chlamydoaleurosporia Grig., 463
  crateriformis Grig., 531
  granulosa Grig., 496
  lacticolor Grig., 501
Chlamydomucor racemosus Bref., 110
Chlamydospore, 17, 19, 106, 453
Chlamydotomus Beigeli Trev., 134
Chloasma, 366
Chlorideae, 667
Choanephora Cunn., 101
  cucurbitarum (Berk. & Rav.) Thaxt., 101
Ciliciopodium Corda, 857
Circinella conica Moreau, 101
  minor Lendner, 101
  spinosa Tiegh. & Lemonnier, *106
  umbellata Tiegh. & Lemonnier, *99
Cladobotryum Nees, 359, 841
Cladosporieae, 669
Cladosporium Link, 669, 671, 674, 675
  madagascarensis Verdun, 845
  Mansoni Pinoy, 678
  penicillioides Preuss, 846
  Wernecki Parreiras Horta, 676
  sp. Guéguen, 845
  sp. Rietmann, 676
Cladothrix Cohn, 706
  Actinomyces Macé, 725, 730

Cladothrix—Cont'd
  asteroides Eppinger, 750
  bovis Macé, 730
  canis Rabe, 748
  cuniculi Macé, 712
  des Erythema migrans Rosenbach, 762
  dichotoma Macé, 713
  Foersteri Cohn, 713
  invulnerabilis Acosta & Grande Rossi, 724
  liquefaciens Hesse, 731
  liquefaciens No. 2 Garten, 726
  Matruchoti Mendel, 734
  odorifera Rullmann, 763
  putridogenes Vezspremi, 761
  sp. Ruiz Casabó, 718
  sp. Thiry, 729
Clavicle, 185
Clavularia Karst., 857
Closteroaleurosporia Audouini Grig., 549
  farinulenta Grig., 502
  gallinae Grig., 555
  Quinckeana Grig., 556
  tarda Grig., 550
  umbonata Grig., 549
Closterospore, 453
Closterospores in Trichophytoneae, *453
Closterosporia Grig., 537
  felinea Grig., 541
  fulva Grig., 541
  gypsea Grig., 553
  lanosa Grig., 542
  pubescens Grig., 544
Coccidiascus Chatton, *127, 131
Coccidioideaceae, 101, 127, 147
Coccidioides Stiles, 101, 147, 155, 157, 341
  brasiliensis Almeida, 156
  esferiformis Moore, 149
  farciminosus Vuill., 169
  immitis Stiles, 147, *148, *150, 156, 165, 166, 219, 220
  immitis strain 2 Hamburger, 341
  pyogenes Rixford & Gilchrist, 148
Coccidium neoplasicum Cantón, 149
Coccidium Seeberia Wernicke, 151
Coemansia Tiegh., 842
Coemansiella Sacc., 824
Cohnistreptothrix Ørskov, 705
Cohnistreptothrix Pinoy, 705, 706
  americana Chalm. & Christ., 716
  bronchitica Verdun & Mandoul, 761
  Carougeaui Chalm. & Christ., 711
  cuniculi Chalm. & Christ., 712
  Israeli Pinoy, 714
  Neschczadimenki Chalm. & Christ., 712
  Rogersi Froilano de Mello, 764
  Silberschmidti Chalm. & Christ., 711
  tenuis Ota, 715
  Thibiergei Chalm. & Christ., 715
  sp. Thjøtta & Gundersen, 713
Colonies, coremiform, 611
  floccose, 611
  funiculose, 612
  in Aspergillaceae, types of, *611
  velvety, 611
Colony of *Paecilomyces Varioti*, *612
Comedones, 361, 366
    grouped, 361, 363

Concretions, 714
Conidia, 19
Conidial stages of *Penicillium*, *615
Conidiophores, 19
Conioscypha Höhn., 822
Coniosporieae, 669
Coniosporium Link, 672, 673
  olivaceum Link, 673
  onicophylum Agostini, 673
  onychophilum Agostini, 673
Conjunctiva, 151
Conjunctivitis, 727, 732, 746
Conservation agar, Sabouraud's, 51, 52
Copulation, anisogamous, 22
  branches, 22
  gametangial, 22
  heterogamous, 22
  isogamous, 22
  oogamous, 22
Coremia, 19, *21
Coremium Link, 857
Corethropsis Corda, 824, 831, 832
  hominis Vuill., 832
  paradoxa Corda, 831, *832
  Puntonii Vuill., 832
Cornea, 115, 215, 280, 719, 729, 732, 746, 764, 793, 843
Corona seborrhoeica, 364
Corylus L., 160
Corynebacterium Lehm. & Neum., 694, 705
  diphtheriae (Klebs) Lehm. & Neum., 232
Cough, 116, 231, 237, 258, 262, 268, 269, 282, 344, 356, 724, 733, 757
Cranial nerves, 167
Cristularia Sacc. (subgenus), 8
Crotch (*see* Inguinocrural region)
Crural region (*see* Inguinocrural region)
Cryptococcus Kütz., 272, 325, 326
  description of genus, 327
  key to pathogenic species, 329, 330
  nomenclature, 326, 327
  pathogenicity, 327-329
  albus Cast. & Chalm., 240
  albus Hlava, 357
  anginae Clerc & Sart., 319
  Bernasconi Font. & Bouch., 355
  Breweri (Verdun) Cast. & Chalm., 252, 337
  brunneus Kütz., 327
  Burnieri Nann., 340
  capillitii Vuill., 360
  capsulatus Cast. & Chalm., 154
  carneus Kütz., 327
  Castellanii Cast., 250
  Cavarae Poll. & Turconi, 280
  cavicola Artault, 348
  cerevisiae (Desm.) Kütz., 327
  coccineus Kütz., 327
  conglobatus (Red.) Poll. & Nann., 330, 334
  Cooperi Dodge, 338
  Copelli Neveu-Lemaire, 338
  corallinus Sart. Sart. Hufschm. & Mey., 353
  Corsellii Neveu-Lemaire, 338
  Costantini Froilano de Mello & Gonzaga Fernandes, 338
Cryptococcus—Cont'd
  de Burnier (cas C) Ota, 281
    (cas S) Ota, 340
    (cas Th) Ota, 347
  de Gougerot et Gancéa Ota, 297
  de Skutetzky Sasakawa, 293
  degenerans Vuill., 339
  dermatitidis Benedek, 244
  dermatitidis Brumpt, 168
  epidermidis Cast. & Chalm., 357
  farciminosus Rivolta, 169
  Farinae Poll. & Turconi, 315
  Favrei Poll. & Nann., 286
  fermentum, Kütz., 326
  Fontoynonti Vuill., 318
  fuscus Font. & Bouch., 355
  Gilchristi Vuill., 168
  glutinis Fres., 327, 351
  Gotoi Dodge, 330, 333
  Gougeroti-Ganceae Ota, 297
  graciloides Cast., 339
  granulomatogenes Vuill., 339
  Guilliermondi Beauverie & Lesieur, 330, 335
  guttulatus Robin, 316, 327, 342
  Harteri Verdun, 178
  Hessleri Cast. & Chalm., 242
  histolyticus Stodd. & Cutl., 330, 337
  hominis Vuill., 330, 341, 343, 345
  hominis var. Costantini Vuill., 338
  hondurianus (Cast.) Dodge, 330, 334
  inaequalis Kütz., 327
  infusionum Kütz., 326, 327
  interdigitalis Poll. & Nann., 277
  irritans Mattl., 356
  Jeanselmei Burnier & Lang., 339
  Kartulisi Cast., 260
  Kleini (Weis) Cohn, 330, 335
  Krausi Ota, 244
  lacrymeatus Jeaume, 251
  laryngitidis Sart., Petges & Claqué, 344
  Lesieuri Beauverie, 249
  Lesieurii Cast. & Chalm., 249
  linguae-pilosae Cast. & Chalm., 260
  lithogenes (Sanfelice) Vuill., 329, 331
  Lowi Cast., 357
  Malassezii Benedek, 360
  Mekundu Mattl., 350
  membranogenes Vuill., 344
  mena Font., 349
  meningitidis Dodge, 329, 330, 333, 337
  metaniger Cast., 675
  minor Poll. & Nann., 244
  Mirandei Velu, 251
  mitis Mazza, Stabile de Nucci & Canal Feijóo, 350
  mollis Kütz., 326, 327
  mutilans Breuil, 339
  myrmecieae Chalm. & Christ., 340
  nasalis (Harrison) Dodge, 330, 332
  natans Kütz., 327
  neoformans (Sanfelice) Vuill., 329, 330, 339
  Neveuxii Vuill. & Lasseur, 329, 330
  niger (Mafucci & Sirleo) Gedoelst, 346
  Otae Nann., 281
  ovalis Vuill., 359

Cryptococcus—Cont'd
  pararoseus Cast., 353
  pinoysimilis Cast., 297
  Plimmeri (Cost.) Neveu-Lemaire, 329, 331
  psicrofilicus Niño, 330, 335
  psoriasis Rivolta, 340
  pyogenes Mattl., 345
  quasi linguae pilosae Cooper, 338
  radiatus Sart. Sart. & Mey., 340, 354
  Rhei Kütz., 327
  Rivoltae Fermi & Aruch, 169
  Rogerii Sart. & Demanche, 254, 255
  rotundatus (Red.) Dodge, 330, 333
  ruber Vuill., 352
  rubrorugosus Cast., 353
  Sakuranei Froilano de Mello & Gonzaga Fernandes, 679
  septicus (Gaetano) Dodge, 340
  Skutetzky Sasakawa, 293
  sulfureus Beauverie & Lesieur, 227
  Tonkini Cast. & Chalm., 357
  uvae Poll. & Nann., 281
  Valerianae Kütz., 327
  vernicosus Kütz., 327
  vini Kütz., 327
  sp. Braafladt, 282
  sp. Brazzola, 346
  sp. Breed, 346
  sp. Cast., 250
  sp. Catanei, 343
  sp. Clerc & Sart., 345
  sp. Conor, 344
  sp. Copelli, 252
  sp. Demanche & Sart., 254
  sp. Gotti & Brazzola, 346
  sp. Hudelo, 309
  sp. Irons & Graham, 341
  sp. Negroni, 280
  sp. Sangiorgi, 350
  sp. Sartory & Orticoni, 261
Ctenomyces Eid., 428, 429, 450
  mentagrophytes Lang. & Miloch., 504
  serratus Eid., *427-429, 455
Culture media, 44-54
Cultures, giant, 60, 61
  micro, 59, 60
  single cell, 61
Cunninghamella Matr., 101
  Bertholletiae Stad., 101
  echinulata Thaxt., 101
Currie's medium, 54
Cylindrocephalum Bon., 824
Cylindrodendrum Bon., 835
Cylindrophora Bon., 835
Cylindrotrichum Bon., 835
Czapek's solution, 49

D

Dacryocystes, 763
Dacryocystitis, 712
Dactylium floccosum Sart., 482
Dactylosporieae, 856
Dalmau's medium, 50, 51
  method for vital staining of fungi, 70
Dandruff (*see* Seborrhea)
Debaryomyces Kloecker, 165, 307, 308, 324
  key to species, 308, 309

Debaryomyces—Cont'd
  Burnieri Ota, 309, 316
  emphysematosus Ota, 308, 311
  Fabrii Dekker, 308, 309, 312
  Fabrii Ota, 312, 313
  globosus Kloecker, 303, 308
  Gruetzii Ota, 308, 315
  Guilliermondii Dekker, 309, 315
  Hildegaardi Ota, 309, 314
  Hudeloi (Goug.) Fonseca, 308, 309, *310, 313, 314
  Kloeckeri Guill. & Péju, 300, *303, 308, 311
    var. *Hudeloi* Dekker, 309
  Laedegaardi Ota, 309, 314
  Leopoldi Ota, 309, *313
  Lundsgaardi Ota, 309, 314
  Matruchoti Grig. & Péju, 308, 309, 312
    race *Gruetzii* Dekker, 315
    race *Hildegaardi* Dekker, 315
  mucosus Sart. & Sart., 308, 310
  Nadsoni Guill. & Péju, 308, 312
  tremoniensis (Ota) Dodge, 313
Decoction, 49, 50
  Duggar's, 49, 50
Dematieae, 665
Dematium Pers., 133, 670, 676, 843
  albicans Laurent, 274
  articulatum Pers., *676
  Gougeroti (Matr.) Grig., 678
  hispidulum (Pers.) Lindau, *677
  Mansoni (Cast.) Dodge, 678
  nigrum Link, 676
  pullulans Bary, 674
  Sakuranei (Jannin) Dodge, 679
  Wernecki (Parreiras Horta) Dodge, 676
Dendrostilbella Höhn., 857
  Boydii Shear, 652, 858
Depazea geicola, 850
Depigmentation, 173
Dermatitis, 215, 286, 335 (*see also* Skin)
  blastomycetic, 264
  erysipeloid, 762
  papillaris capillitii, 365
  seborrheic, 361
  verrucosa, 848
Dermatophytes (*see* Trichophytoneae)
Dermatosis (*see* Skin)
Deuterogamy, 22
Dhobie itch, 437, 487, 488
Diarrhea, 245, 262, 264, 352
Dicaryon, 23
Didymocladium Sacc., 853
Didymopsis Sacc., 853
Didymostilbe Bres. & Sacc., 858
Digestive tract, 156, 204, 205, 237, 792
Dikwakwadi, 443, 561
Dilution of organisms, 58, 59
Diphtheria, 344, 860
Diplocladium Bon., 853
Diplorhinotrichum Höhn., 851
Diplosporium Bon., 851, 853
  nigrescens Link, 853
  vaginae Nann., 853, *854
Diplostephanus nidulans Neveu-Lemaire, 636
  var. *Nicollei* Neveu-Lemaire, 637
Dipodascaceae, 126, 127, 145

- *Dipodascus* Lagerh., 126, 145
  - *albidus* Lagerh., *144
- *Discomyces* Rivolta, 706
  - *algiris* Blanchard, 682
  - *asteroides* Gedoelst, 750
  - *bahiensis* Pirajá da Silva, 740
  - *bovis* Brumpt, 714
  - *bovis* Rivolta, 730
  - *brasiliensis* Lindenberg, 749
  - *bronchialis* Neveu-Lemaire, 757
  - *buccalis* Brumpt, 755
  - *candidus* Verdun & Mandoul, 725
  - *caprae* Gedoelst, 748
  - *carneus* Neveu-Lemaire, 741
  - *Carougeaui* Goug., 711
  - *cati* Rivolta, 762
  - *congolensis* Baerts, 809
  - *convolutus* Neveu-Lemaire, 745
  - *cylindraceus* Neveu-Lemaire, 716
  - *Dassonvillei* Neveu-Lemaire, 727
  - *decussatus* Lang. & Chevalier, 760
  - *Dori* Beurm. & Goug., 762
  - *enteritidis* Verdun & Mandoul, 762
  - *farcinicus* Gedoelst, 746
  - *Foersteri* Gedoelst, 714
  - *Freeri* Neveu-Lemaire, 742
  - *Garteni* Brumpt, 726
  - *indicus* Neveu-Lemaire, 739
  - *Israeli* Gedoelst, 714
  - *Lasserrei* Neveu-Lemaire, 763
  - *lingualis* Brumpt, 722
  - *liquefaciens* Neveu-Lemaire, 731
  - *luteolus* Verdun & Mandoul, 732
  - *Madurae* Gedoelst, 739
  - *minutissimus* Verdun, 741
  - *Pelletieri* Neveu-Lemaire, 764
  - *Pijperi* Neveu-Lemaire, 756
  - *Ponceti* Neveu-Lemaire, 754
  - *pulmonalis* Brumpt, 758
  - *Rivierei* Neveu-Lemaire, 721
  - *Rosenbachi* Gedoelst, 762
  - *Somaliensis* Neveu-Lemaire, 765
  - *tenuis* Cast., 715
  - *Thibiergei* Ravaut & Pinoy, 715
  - sp. Senez, 766
- Dog, 509, 679
  - bronchitis, 749
  - cerebromeningitis, 749
  - favus, 430
  - lymphadenitis, 749
  - pyrexia, 350
  - skin, 430, 543, 560, 728, 789, 859
- Donkey, (*see* Ass)
- *Doratomyces* Corda, 824
- Dromedary, skin, 517
- *Drosophila*, 131
- Duggar's decoction, 49, 50
- Dysentery, 143, 225, 226, 268, 278, 284, 356
- Dysidrosis, 205, 439, 480, 481, 766
  - lamellosa sicca, 440
- Dyspnea, 116, 282

E

- Ear, 112, 113, 151, 622, 628, 629, 631, 633, 636, 641, 766
  - external, 111, 182, 185, 233, 625, 716
- Ecthyma, 355
- *Ectotrichophyton* Cast. & Chalm., 432, 442, 447, 451, 458, 460, 461, 476, 486, 488, 493, 494, 537
  - key to species, 494-496
  - *album* Cast. & Chalm., 515
  - *circuluscentricum* (Magalhães) Dodge, 458, 459, 496, 503
  - *denticulatum* Cast. & Chalm., 498
  - *discoides* Cast. & Chalm., 514
  - *chimeense* (Fujii) Dodge, 496, 506
  - *equinum* Cast. & Chalm., 510
  - *erioton* (Caz.) Dodge, 458, 495, 500
  - *eriotrephon* (Papegaaij) Dodge, 459, 494, 496, 497
  - *farinulentum* (Sab.) Cast. & Chalm., 455, 456, 458, 460, 495, 502, 503, 512
  - *felineum* (Blanchard) Cast. & Chalm., 454, 458, 461, 468, 494, 497
    - var. *denticulatum* (Sab.) Dodge, 454, 495, 498
  - *granulosum* (Sab.) Cast. & Chalm., 459, 466, 468, 470, 494, 496
  - *griseum* (Fischer) Dodge, 458, 495, 499
    - var. *brasiliense* Dodge, 495,499
  - *Kagawaense* (Fujii) Dodge, 496, 506
  - *lacticolor* (Sab.) Cast. & Chalm., *454, 455, 459, 460, 468, 480, 495, 496, 501, 512
  - *luxurians* Cast. & Chalm., 519
  - *Megnini* Cast. & Chalm., 510
  - *mentagrophytes* (Robin) Cast. & Chalm., 437, *454, 455, 458, 459, 466, 467, 469, 471, 473, 474, 493, 496, 498, 504, 547, 646
    - var. *chibaense* (Ogata) Dodge, 496, 506
    - var. Gonzales Urueña, 440
    - var. *radiolatum* (Bruhns & Alex.) Dodge, 454, 456, 466, 505, 548
  - *multicolor* (Magalhães & Neves) Dodge, 458, 461, 495, 500
  - *Nakamurae* Dodge, 495, 502
  - *nodoformans* Cast. & Chalm., 511
  - *ochraceum* Cast. & Chalm., 521
  - *Otae* Dodge, 488, 495, 500
  - *persicolor* Cast. & Chalm., 486
  - *radiolatum* Cast. & Chalm., 505
  - *radioplicatum* (Fischer) Dodge, 498
  - *scorteum* (Priestley) Dodge, 458, 461, 495, 503
  - *verrucosum* Cast. & Chalm., 526
  - *vinosum* Cast. & Chalm., 511
- Eczema, 174, 316
  - generalized, 718
  - marginatum, 435-437, 482, 487, 488, 545
    - frequency of, 439
    - prophylaxis, 439
  - rubra, 361
  - seborrhoicum, 361, 514
- Edema, 209, 287, 729
- *Eidamella spinosa* Mat. & Dass., *427, 430, 509
- Elbow, 801
- Emaciation, 153
- Embedding fungi, Jeffrey's procedure, 72, 73
  - nitrocellulose method, 71, 72
  - paraffin method, 71
- *Emericella nidulans* Vuill., 636

Emphysema, 636
Empyema, 740
Enantiothamnus Pinoy, 200, 272, 273
  Braulti Pinoy, 200, 277
Encephalitis lethargica, 753
Endoblastoderma Fischer & Brebeck, 199
Endodermophyton Perry, 460, 476, 489
  africanum Dodge, 490
  Castellanii Perry, 490
  concentricum (Blanchard) Cast. & Chalm., *451, 489, 490, 525
  concentricum Ota & Kawatsure, 491, 492
  indicum Cast., 491
  Mansoni Brumpt, 490
  Roquettei Fonseca, *492
  tropicale Cast. & Chalm., 492
    aleurospores, *454
    closterospores, *453
    mycelium, *449
Endomyces Reess, *127, 137, 142, 162, 164, 166
  albicans Johan-Olsen, 274
  albicans Okabe, 174
  albicans Vuill., 136
  Blanchardi Cast., 243
  bonaerensis Greco, 175
  burgessi Cast., 255
  candidus Cast., 270
  capsulatus Dodge & Ayers, 167
  crateriforme Hudelo, Sart. & Montlaur, 174
  Cruzi Froilano de Mello & Paes, 176
  decipiens (Tul.) Reess, *139
  dermatitidis Moore, 168
  enterica Cast., 264
  faecalis Cast., 254
  farciminosus Nègre & Boquet, 169
  Guilliermondi Cast., 257
  insolitus Cast., 258
  intestinalis Cast., 253
  Krusei Cast., 231
  Magnusii Ludw., *138
  Molardi Salvat & Font., 173
  Negrii Cast., 253
  nitidus Cast., 261
  niveus Cast., 256
  paratropicalis Cast., 264
  paratropicalis B Cast., 231
  paratropicalis D Cast., 257
  Perryi Cast., 243
  Pinoyi Cast., 285
  pseudotropicalis Cast., 259
  pseudotropicalis C Cast., 261
  pulmonalis Cast., 255
  pulmonalis Senez, 179
  rhoi Cast. & Chalm., 233
  rotundatus Cast., 220
  rugosus Cast., 219
  subtilis Cast. & Chalm., 228
  tropicalis Acton, 146
  tropicalis Cast., 146, 258
  Vuillemini Froilano de Mello & Gonzaga Fernandes, 245
  Vuillemini Lindau, 136
  sp. Carpano, 298
Endomycetaceae, 126, 127, 137
  key to genera, 142
Endomycetales, 101, 161, 186, 425, 450, 666
  definition of, 126
  key to families, 126, 127
  spore shapes, *127
Endomycopsis Dekker, 139, 142, 166
  albicans Dekker, 136
  capsularis (Schönn.) Dekker, 141
  fibuliger (Lindner) Dekker, *140
  Hordei (Saito) Dekker, 140
  javanensis (Klöcker) Dekker, 141
  Lindneri (Saito) Dekker, 140, *141
Entamoeba coli, 262
Enteritis, 220, 225, 226, 278, 284
Epidermidophyton Lang, 477
Epidermis, 478, 479
Epidermomycosis, 281, 316, 340, 347, 484
  generalized, 490, 507
Epidermophyton Mégnin, 477
Epidermophyton Sab., 273, 429, 435, 439, 459, 460, 465, 466, 476, 477, 478, 487, 494, 736, 830, 849
  key to species, 478, 479
  cerebriforme Dodge, 478, 479
  clypeiforme MacCarthy, 483
  cruris Cast. & Chalm., 482
  floccosum (Harz) Lang. & Miloch., 440 459, 467, 469, 470, 473, 474, 478, 481
    var. *clypeiforme* (MacCarthy) Dodge, 483
  gallinae Mégnin, 554
  gypseum MacCarthy, 460, 478, 480
  inguinale Kurotchkin & Chen, 481
  inguinale Sab., 440, 467, 474, 480, 482
  interdigitale (Priestley) MacCarthy, 438, 440, 469, 470, 472, 478, 480
  lanoroseum MacCarthy, 459, 478, 484, 501
  niveum MacCarthy, 460, 478, 479
  pedis (Ota) Dodge, 460, 472, 478, 480, 481
  Perneti Cast., 479, 488
  persicolor (Sab.) Dodge, 459, 479, 486
  plicarum Nicolau, 482
  plurizoniforme MacCarthy, 459, 478, 484
  purpureum (Bang) Dodge, 459, 472, 479, 485, 488
  repens (Eklund) Sart., 489
  rubidum (Priestley) Dodge, 459, 479, 486, 487
  rubrum Cast., 289, 432, 440, 459, 469, 479, 484, 487, 488, 501
  salmoneum Froilano de Mello, 459, 478, 484, 487, 511
  variabile Karrenberg, 481
  sp. Bazin, 358
  sp. Cremer, 479
Epididymis, 322
Eremascaceae, 126, 127
  key to genera, 165
  morphology, 161-165
Eremascaceae Imperfectae, 186, 665, 666
  classification, 194-204
  key to genera, 206, 207
  methods of study, 186-188
  morphology, 188-194
  pathogenicity, 204-206

Eremascus Eidam, 145, 165, 180
  albus Eidam, 161, *162
  fertilis Stoppel, 161, *162
Eremothecium Borzi, 130
Erosio interdigitalis, 766
Erythema, 287
Erythrasma, 723, 741
Espundia, 341
Euectotrichophyton Cast. & Chalm., 493, 509
Eumicrosporum Sab., 447, 461, 537, 539, 545, 548
Eurotiella Lindau, 652
Eurotiopsis Cost., 652
  Gayoni Cost., 652
Eurotium Amstelodami Mangin, 630
  diplocyste Sart., Sart., Hufschm. & Mey., 625
  malignum Lindt, 632
  rubrum Spieckermann & Bremen, 630
Eutorula Will, 325, 354, 355
  key to species, 355
  Bernasconi (Font. & Bouch.) Dodge, 355
  fusca (Font. & Bouch.) Dodge, 355
  irritans (Mattl.) Dodge, 356
  vulgaris Will, 354
Eutorulopsis Cif., 327, 354
Exoascoses, 159
Exudates, staining of, 70
Eye, 645, 805, 831
Eyelid, 765

F

Face, 175, 245, 251, 260, 340, 351, 493, 511, 536
Falchi's medium, 54
Farcy, 746
Farley's medium, 53
Favic scutulum, 440
Favotrichophyton Cast. & Chalm. (Subgenus), 512
Favotrichophyton Neveu-Lemaire, 134, 435, 447, 458-460, 463, 476, 486, 493, 512
  general discussion, 512, 513
  key to species, 513, 514
  abissinicum (Agostini) Dodge, 460, 513, 517
  album (Sab.) Neveu-Lemaire, 460, 469, 512, 513, 515, 521
    hyphal tips, *452
    pedicillate chlamydospores, *452
  avellaneum Dodge, 514, 525, 529
  balcaneum (Cast.) Dodge, 460, 513, 518
  caballinum Neveu-Lemaire, 514, 521
  camerounense (Ota & Gaill.) Dodge, 513, 515, *516
  ceroton (Caz.) Dodge, 513, 519
  cinereum (Caz.) Dodge, 513, 519
  coccineum (Katoh) Dodge, 514, 524
  conicum (Caz.) Dodge, 514, 521
  coronatum (Caz.) Dodge, 513, 520
  discoides (Sab.) Neveu-Lemaire, 460, 512-514, 521
  epilans (Mégnin) Dodge, 526
  expansum (Caz.) Dodge, 513, 520
  flavirirens (Americo da Veiga) Dodge, 460, 513, 518
  floreale (Caz.) Dodge, 513, 517
Favotrichophyton—Cont'd
  floriforme (Beintema) Dodge, 513, 518
  fuligineum (Ogata) Dodge, 514, 526
  glabrum (Sab.) Dodge, 465, 514, 522
  Gourvili (Catanei) Dodge, 514, 522
  Langeroni (Baudet) Dodge, 513, 517, 525
  luxurians (Brault & Viguier) Neveu-Lemaire, 513, 518
  ochraceum (Sab.) Neveu-Lemaire, 135, 440, 469, 512, 514, 521
    aleurospores, *454
    mycelium, *449
    pedicillate chlamydospores, *452
  pruinosum (Catanei) Dodge, 513, 520
  singulare (Caz.) Dodge, 460, 512, 513, 515
  spadix (Katoh) Dodge, 514, 524
  Urenae (Ochoterena) Dodge, 460, 513, 517, 528
  verrucosum (Bodin) Neveu-Lemaire, 514, 525
  violaceum (Sab.) Dodge, 437, 440, 460, 465-467, 469, 473, 488, 512, 514, 522, 523, 525, 528, 533
    aleurospores, *454
    arthrospores, *451
    closterospores, *453
    intercalary chlamydospores, *452
    var. *coccinatum* Dodge, 514, 524
    var. *khartoumense* (Chalm. & Macdonald) Dodge, 514, 523
    var. *marginatum* (Muijs) Dodge, 514, 524
Favus, 430, 440-443, 553-560
  confertus, 557
  scutiformis, 441
  squarrosus, 441
  turriformis, 557
  urceolaris, 441
Favuspilz α Quincke, 555
Favuspilz β Quincke, 558
Feces, 143, 177, 218, 220, 223, 225, 226, 238, 245, 253, 254, 258, 259, 262, 264, 268, 278, 284, 312, 317, 352, 354, 356
Fermentation, 62, 63
  determination of, by Lindner's micromethod, 63
    by tube method, 63, 64
Fertilization, 21
Fetus, 117
Fever, rat-bite, 759
  weasel-bite, 759
Figueira, 849
Filtration, use in sterilization, 48
Fingers, 296
Fistula, 173, 260
Fixing agents, 71
    Benda's fluid, 71
    Flemming's strong agent, 71
    Flemming's weak agent, 71
    Hermann's fluid, 71
Flannel rash, 361, 365
Flaschenbacillus Unna, 359, 360
Flask bacillus, 365
Flemming's agent for fixing fungi, strong and weak, 71

Flux sebacea, 361
Folliculitis depilans of dog, 509
 disseminated, 540
Foot, 209, 214, 242, 355, 438, 439, 479, 480, 484, 489, 533, 630, 637, 639, 640, 645, 652, 681, 721, 730, 735, 736, 738-740, 756, 761, 763, 795, 796, 810, 849
Forehead, 677
Formes à souffrance, 450
Fowl, 555
 abdominal cavities, 719
 favus, 430
 pseudotuberculosis, 324
Foxia Mansoni Cast., 678
Fructification, 19
Fulmer & Grimes' medium, 54
Fumago Pers., 678
Fungi, definition, 17
Fungi Imperfecti, 21, 24, 25, 121
 general discussion, 665, 666
 key to larger groups, 666-668
Fungistasis in Trichophytoneae, 472-474
Furunculosis, 250
Fusariopsis Derrieni Parreiras Horta, 860
Fusarium Link, 830
 equinum Növgaard, 540
 Moronei Curzi, 859
 vinosum Greco, 859
 sp. Frei, 859
Fusoma Corda, 463
 cruris Vuill., 482

G

Gametangia, 22
Gametes, 21
Gasteroenteritis, 259
Gastritis, 335
Gastrointestinal tract, 651
Genitalia, 205, 270 (*see also individual organs*)
 male, 281
Geotrichoides Lang. & Tal., 191, 201, 206, 208, *230, 266, 273
 asteroides Lang. & Tal., 210
 Balzeri Lang. & Tal., 212
 cutaneus Lang. & Tal., 211
 Krusei Lang. & Tal., 231
 tumefaciens Tal. & Mack., 231, 291
Geotrichum Link, 156, 166, 206, 207, 215, *216, 234
 general discussion, 215-217
 key to species, 217
 nomenclature, 196, 197
 asteroides (Cast.) Basgal, 217, 218
 Bogolepoffi Basgal, 831
 bostonense Dodge, 217, 223
 brasiliense Cif. & Red., 157
 Brocqi Cast. & Jacono, 210
 candidum Link, 215, 703
 Caoi Basgal, 225
 dermatitidis Basgal, 168
 famatum (Harrison) Dodge, 217, 218
 immite (Cast.) Agostini, 149, 217, 219
 lactis, 134
 louisianoideum Cast., 217, 220
 matalense Cast., 296
Geotrichum—Cont'd
 membranogenes (Martins) Dodge, 222
 Muisa (Mattl.) Dodge, 217, 220
 multifermentans Cast., 228
 pulmonale (Cif. & Red.) Dodge, 217
 pulmoneum (Bennett) Basgal, 217
 rotundatum (Cast.) Almeida, 217, 220
 rugosum (Cast.) Dodge, 217, 219
 Sakuranei Almeida, 679
 subtile Almeida, 228
 versiforme Moore, 216, 217, 221, *222
Giant cultures, 60, 61
Gibellula Cav., 858
Gilchristia Red. & Cif., 165
 dermatitidis Red. & Cif., 168
Gingivitis, 828
Glands, neck, 346
Glassware, cleaning of, 44, 45
Glenospora albiciscans Ota, 788
 brevis Cast., 790
 Clapieri Catanei, 794
 Gammeli Poll. & Nann., 792, 793
 gandavensis Vuill., 794
 Graphii Vuill., 793
 khartoumensis Chalm. & Archibald, 793
 lanuginosa Agostini, 792
 metaeuropea Cast., 790
 metamericana Cast., 790
 Semoni Chalm. & Archibald, 794
Glenosporella albiciscans Nann., 788
 dermatitidis Agostini, 789
Gliobotrys Höhn., 850
Gliocladium Corda, 826
 roseum (Link) Bain., *616
Gliosphaera Höhn., 842
Glossitis, 352
Glucose agar, Sabouraud's, 186
Gluteal region, 260, 278, 321, 437
Glycyphila Mont., nomenclature, 198, 199
Goat, lungs, 633, 748
Goldschmidt's medium, 52
Gomphinaria Preuss, 850
 amoena Preuss, 850
 Pedrosoi (Brumpt) Dodge, 850, *851
Gonatobotrytideae, 667, 834
Gonococcemia, 337
Gonotoconts, 20
Gorodkova's agar, 306
 Maneval's modification of, 306
Grains, black, 355, 675, 682-685, 793, 794, 840, 860
 greenish yellow, 765
 red, 214, 761, 795
 white, 652, 715, 739, 740, 756, 758
 yellow, 630, 731, 735, 738, 740, 745, 747, 763
Gram-Weigert method of staining, 69
Granuloma, 448, 744, 838
 of Majocchi, 448
 venereal, 649
Graphiothecium Fuckel, 858
Graphium Corda, 810, 858
Grigorakis' medium, 53
 spleen medium, 53
Groin (*see* Inguinocrural region)
Grubyella Ota & Lang., 463, 512, 551
 alba Ota & Lang., 515

Grubyella—Cont'd
  angolensis Brumpt, 561
  caballina Brumpt, 522
  camerounensis Ota & Gaill., 515
  chosenica Takahashi, 508
  discoides Ota & Lang., 514
  farciminosa Ota & Lang., 169
  ferruginea Ota & Lang., 545
  Langeroni Baudet, 517, 525
  luxurians Brumpt, 519
  ochracea Ota & Lang., 521
  Schoenleini Ota & Lang., 558
    var. *mongolica* Hashimoto & Ota, 559
Gruetz' medium, 52
Guilliermondella Nadson & Krass., *127, 136
  Vuillemini (Lindau?) Dodge, 136
Guinea pig, lung, 347, 348
  septicemia, 340
Gumma, 211, 212, 227, 645, 678, 791, 805, 822, 829, 832, 837, 844
Gums, 341
Gutstein method of staining spores, Maneval's modification, 68
Gymnoascaceae, 425-429, 454, 455, 665, 666
  key to genera, 429
  Imperfectae, 667, 668
Gymnoascus Baran., 425, 429
  gypseus Nann., *427, 430, 433
  Reessii Baran., 426
  setosus Eidam, 426, *427, 429, 509
  uncinatus Eidam, 426

H

Hair, 132-134, 340, 353, 431, 517, 518, 522-526, 529-535, 540, 541, 543-545, 547-550, 554-558, 561, 651, 715 (*see also* Beard)
  follicles, 510
  in favus, *442
  in tinea tonsurans, *447
  in tinea tonsurans microsporica, *444
  infection by Trichophytoneae, 440-448
  pubic, 135
Haja, 736
Halobyssus moniliformis var. *parasiticus* Maffei, 686
Halogens, use in sterilization, 45, 46
Hand, 209, 248, 287, 479, 480, 489, 506, 508, 635, 645, 796, 804, 843, 856
Hansenia Zikes, 341
Hanseniospora Zikes, 126, 137, 142, 143
  Guilliermondii Pijper, 141, 143
Hansenula Sydow, 137, 141, 142, 191
  cell types, *193
  anomala Sydow, 142
  bispora Nann., 143
Haplaria Link, 835
Haplariopsis Oud., 851
Haplographieae, 667, 843
  key to genera, 843
Haplographium Berk. & Br., 843, 844
  chlorocephalum (Fres.) Grove, *844
  DeBella-Marengoi Poll., 844
    var. *equinum* Poll., 845
    var. *pulmonale* Red., 845
  delicatum Berk. & Br., 844
Haplosporangium Thaxter, 98, 104
  bisporale Thaxter, 105
Haplotrichum Link, 824
Harpographium Sacc., 858
Harziella Cost. & Matr., 842
Haustoria, 18
Head, 319, 637
Heavy metals, salts of, used in sterilization, 46
Hedgehog, skin, 556
Hefe Copelli Sasakawa, 252
Hefe emphysematosus Sasakawa, 311
Hefe Fabry, 312
Hefe Goto, 333
Hefe Hagiwara, 319
Hefe Hashimoto, 260
Hefe Lundsgaard Sasakawa, 314
Hefe Ota, 340
Helminthiasis, 312
Hemispora Vuill., 164, 165, 182, 183, 370, 651
  coremiformis Moore, *21, 182, *184
  pararugosa Cast. & Chalm., 219
  pararugosa Cast. & Douglas, 225
  stellata Vuill., 182, *183, 650
Hepatitis, 293
Hermann's fluid for fixing fungi, 71
Hermaphroditic mycelium, 21
Herpes, 529
  circinatus, 431, 434, 523, 524, 543, 551, 556
  desquamans, 434
  tonsurans, 434
Heterogamy, 22
Heterothallic mycelium, 21
Heydenia Fres., 858
Hibiscus japonicus Miq., 288
  Manihot L., 288
Hibler's brain medium, 53
Histoplasma Darling, 145, 147, 152
  capsulatum Darling, 152, *153, 155
  farciminosum Red. & Cif., 169
  pyriforme (Moore) Dodge, *154, 155
Hodi potsy, 846
Holdfasts, 18
Homothallic mycelium, 21
Hongkong foot, 487
Hongo artrosporado Ribeyro, 735
Hormiactella Sacc., 843
Hormiactis Preuss, 853
Hormiscium Hoffman, 669, 672
  pinophilum Nees, *672
  stitlosporum Corda, *672
Hormodendron Bon., 674, 843, 845, 849, 857
  algeriensis Montpellier & Catanei, 845
  Fontoynonti Lang., 846, *847
  Langeroni Fonseca, Arêa Leão & Nogueiro Penido, 847
  leproides (Leger & Nogue) Dodge, 848
  madagascarensis (Verdun) Dodge, 845
  olivaceum (Corda) Bon., 845, *846
  Pedrosoi Brumpt, 850
  rossicum Meriin, 848
  sp. Lang., 845
Hormonema Lagerberg, Lundberg & Melin, 673
Horse, 114, 115, 283, 720, 737, 803
  adenitis, 113
  hair, 136
  jaw, 758

Horse—Cont'd
  lung, 337
  lymphatics, 169
  nasal tumor, 332
  nose, 113, 346
  pleuropulmonitis, 298
  saliva, 734
  skin, 169, 496, 504, 510, 515, 521, 522, 526, 539, 540, 553, 554, 728
  tumor, 111
Hyalococcus Beigeli Schröt., 134
Hyalodidymeae, 668
  key to genera, 851, 853
Hyalopus Corda, 824
  anoma Boucher, 824
  muscorum Corda, *825
  onychophilus (Vuill.) Aschieri, 825
Hyalostilboideae, 857
Hydrarthrosis, 797
Hydrogen ion concentration, 34-38
Hydrotropism, 40
Hymenium, 20
Hyperidrosis oleosa, 361
Hyperleucocytosis, 231
Hyphae, 17
  ascogenous, 122
Hyphal tips in Trichophytoneae, *452
Hyphomycetes, 665, 666
Hypnospore, 17, *18, 19
Hypopyokeratitis, 314

I

Immunology in Trichophytoneae, 474-476
Indiella Brumpt, 669, 685, 809
  americana Delamare & Gatti, 838
  Brumpti Pirajá da Silva, 686
  Mansoni Brumpt, *686
  Reynieri Brumpt, 686
  somaliensis Brumpt, 765
Indielopsis somaliensis Brumpt, 765
Infiltration, 211
Infusion, 49
Inguinocrural region, 278, 286, 337, 437, 481, 484-488, 511, 731
Inhibitors of growth, 59
Inoculations of organisms, 64, 65
Inorganic salt requirements of fungi, 32
Intercalary chlamydospores in Trichophytoneae, *452
Interdigital spaces, 205, 278, 281, 288, 298, 312, 313, 321, 339, 438, 479-481, 483, 508, 736, 766
Intertrigo, 810
Intestinal tract, 153, 178, 283
Ipomoea Batalas Poir., 341
Isaria Pers., 832, 857
Isariopsis Fres., 858
Isogamy, 22
Isolation of organisms, 57-65
    from feces, 58
    from skin lesions, 57, 58
    from tongue scrapings, 58

J

Jaw, 185, 318, 498, 734, 755, 761, 794, 844
Jeffrey's method of embedding fungi, 72, 73
Jewish washerwomen's disease, 205
Jock-strap itch, 437
Joints, 149

K

Kambayashia Dodge (subgenus), 461, 537, 538, 545
Kangaroo, lumpy jaw of, 747
Keara, 676
Keratodermia plantare sulcatum, 736
Keratolysis plantare sulcatum, 736
Keratomycosis, 831, 843
Keratosis, 363
Kerion, 446, 497, 498, 501, 502, 504, 505, 507, 514, 518, 519, 521, 542, 547, 553, 554, 558
Kidneys, 763
Klebs' dicta, 31
Kloeckera Janke, 342
Kloeckeria Janke, 341
Knee, 808
Kojiserum agar, 248

L

Lacrimal canal, 714
  sac, 151
Lactophenol, Amann's solution, 67
Larynx, 341
Leg, 173, 282, 349, 355, 503, 560, 674, 677, 678, 735, 750, 828, 846, 847
Leishmania farciminosa Galli-Valerio, 169
Lendner's medium for cultivating Mucorales, 109
Lepidophyton concentricum Gedoelst, 490
  sp. Tribondeau, 490
Lepocolla repens Eklund, 489
Leprosy, 848, 850
Leptomitus Plumula Kütz., 326
Lesions, ectoendothrix, 515
  ectothrix, 480, 498, 503, 505, 506, 509
    megaspore, 520
  endothrix, 515, 522, 524, 531, 532
Leucocytozoon piroplasmoides Ducloux, 169
Leucopenia, 153
Levure de Favre Ota, 286
Levure de Kartulis Sasakawa, 260
Levure Guilliermond & Lesieur, 335
Lichen circinatus, 361
  planus, 499
Lichenification, 365
Lichtheimia Vuill., 111, 113
  corymbifera Vuill., 112
  italiana Cost. & Perin, 112
  italica Poll. & Nann., 112
  ramosa Vuill., 113
  Regnieri Vuill., 114
Light, influence on fungi, 39
Limbs, 341
Lindner's microfermentation method, 63
Lingua nigra, 116, 338
    pilosa, 238, 260, 343, 722
Lips, 242, 322, 361
Liver, 153, 178, 716
Loeffler medium, modified, 248
Lophophyton Matr. & Dass., 476, 551
  (as subgenus), 552
Lophophyton gallinae Matr. & Dass., 555
Lumbar region, 245, 320, 486
Lumpy jaw, 731, 747

Lung, 113, 116, 117, 149, 153, 156, 157, 178, 181, 220-222, 231, 236, 242, 249, 254, 262, 264, 292, 295, 321, 333-335, 352, 622, 634, 646, 651, 716, 717, 722, 740, 745, 747, 753, 756, 758, 763, 764, 766, 792, 798, 811
Lymph nodes, 153, 557
Lymphangitis, epizootic, 169
  gummatous, 646
Lymphatics, 156
Lymphatic ganglia, 679
Lymphosporidium equi Gasperini, 169

M

Macacus rhesus, 154
Macleod medium, 53
Macroglossia, 242
Macrosporieae, 856
Madura foot, 637, 680, 682, 685, 730, 735, 740, 763 (*see also* Mycetoma)
Madurella Brumpt, 162, 299, 491, 622, 650, 669, 676, 680, 681, 794
  key to species, 681
  algiris (Blanchard) Dodge, 681, 682
  americana Gammel, 681, 684
  Bouffardi (Brumpt) Dodge, 685
  Bovoi Brumpt, 685
  Ikedae Gammel, 681, 683
  mycetomi (Laveran) Brumpt, *680, 684, 685
  Oswaldoi Parreiras Horta, 681, 682
  Ramiroi Pirajá da Silva, 681, 682
  Tabarkae Blanc & Brun, 681, 683
  Tozeuri (Nicolle & Pinoy) Pinoy, 681
Maduromycosis (*see* Mycetoma)
Majocchi, granuloma of, 448
Malaria, 318
Malassezia Baillon, 325, 358
  furfur (Robin) Baillon, 358
  Maofadyeni Cast., 369
  muris Escomel, 556
  ovalis (Bizz.) Acton & Panja, 359, *368
    cultural character of, 366, 369
    discussion of lesions, 361-366
    infections, therapeusis of, 369
    morphology of, 366, 367
  pachydermatis (Weidm.) Dodge, 370
  tropica (Cast.) Schmitt., 369
  sp. Escomel, 556
Matbranchea Sacc. & Penzig, 705, 706
  Bolognesii-Chiurcoi Vuill., 766
Mallory's aniline blue stain, 68
Malmstenia Dodge (subgenus), 445, 527-531, 533, 534, 536
Maneval method of staining spores, 67
  modification of Gorodkova's agar, 306
Mango toe, 736
Martensella microspora Vuill., 549
Mastigocladium Blochi Matruchot, 646
Matruchotiella Currii Grig., 431
Medium, 44-54
  Benedek's, 53
  corn meal, 51
  Currie's, 54
  Czapek's, 49
  Dalmau's, 50, 51
  Duggar's decoction, 49, 50
Medium—Cont'd
  Falchi's, 54
  Farley's, 53
  Fulmer & Grimes', 54
  Goldschmidt's, 52
  Gorodkova's, 306
  Grigorakis', 53
    spleen, 53
  Gruetz, 52
  Hibler's brain, 53
  Kojiserum, 248
  Lendner's, 109
  liquid, 49, 50
  Maneval's modified Gorodkova, 306
  meat infusion, 49
  modified Loeffler, 248
  Norris', 54
  Pennsylvania, 52
  Pollacci's, 52, 53
  potato juice, 727
  Sabouraud conservation, 51, 52
    test, 52
  solid, 50-54
  starch, 51
  vegetable plugs, 50
Medulla, 167
Megalocitosporides Wernicke, 149
Megatrichophyton Neveu-Lemaire, 461, 476, 500, 509
  key to species, 509
  caninum (Matr. & Dass.) Dodge, 461, 509
  equinum (Gedoelst) Neveu-Lemaire, 461, 509
    hyphal tips, *452
    intercalary chlamydospores, *452
    pedicellate chlamydospores, *452
    mycelium, *449
    nodular organs, *450
    pectinate organs, *450
  Megnini Neveu-Lemaire, 510
  nodoformans (Cast.) Neveu-Lemaire, 511
  roseum (Bodin) Dodge, 461, 466-470, 509, 510, 555
    var. *vinosum* (Sab.) Dodge, 468, 469, 509 511
      aleurospores, *454
      closterospores, *453
      intercalary chlamydospores, *452
  vinosum Neveu-Lemaire, 511
Meiosis, 21
Meninges, 149, 254
Meningitis, 333, 750
  Torula, 327-329
  tuberculous, 328
Meningoencephalitis, 167, 335
Mentagrophytes Gruby, 504
Merogamy, 22
Mesenteric glands, 237
Metulae, definition of, 614
Mice, 553
  cornea, 556
  skin, 556
Micraloa rosea Kütz., 327
Microblastosporion Cif., 325, 357
Micrococcus Beigeli Migula, 134
  melitensis Bruce, 350
  Pelletieri Laveran, 764

- Microcultures, 59, 60
- *Micromonospora* Ørskov, 705
- *Micromyces* Gruber, 706
  - *Hofmanni* Gruber, 742
- Micronemeae, 856
- Microscopy, 66-73
- *Microsporioides minutissimus* Neveu-Lemaire, 741
- *Microsporon* Robin, 132 (*See also Microsporum* Gruby)
  - *furfur* Robin, 358
  - *gracile* Balzer, 741
  - *Macfadyeni* Cast., 369
  - *mentagrophytes* Robin, 504
  - *minutissimum* Burchard, 741
- *Microsporum* Gruby, 132, 429, 444, 446, 448, 458, 461, 476, 494, 537
  - key to species, 537-539
  - *amethysticum* Weidman, 489
  - *anomeon* Vidal, 551
  - *Audouini* Gruby, 440, 447, 466, 467, 469, 471, 474, 537, 539, 543, 549, 550
    - mycelium, *449
    - forma *pertenue* (Plaut) Dodge, 539, 551
    - var. *depauperatum* (Guéguen) Dodge, 539, 551
    - var. *equinum* Delacroix & Bodin, 540
    - var. *macrosporium* Craik, 543
    - var. *tardum* (Sab.) Dodge, 539, 550
    - var. *velveticum* (Sab.) Dodge, 539, 550
  - *Audouini* Vuill., 359
  - *aureum* Takeya, 538, 547
  - *brachytomum* Ono, 551
  - *caninum* Sab., 542
  - *canis* Bodin, 468-470, 538, 542.
    - pectinate organs in, *450
  - *circuluscentricum* Magalhães, 503
  - (*Closteroaleurosporia*)
    - *Audouini* Guiart & Grig., 549
    - *farinulentum* Guiart & Grig., 502
    - *persicolor* Guiart & Grig., 486
    - *Quinckeanum* Guiart & Grig., 556
    - *tardum* Guiart & Grig., 550
    - *umbonatum* Guiart & Grig., 549
  - (*Closterosporia*)
    - *asteroides* Guiart & Grig., 504
    - *gypseum* Guiart & Grig., 553
    - *felineum* Guiart & Grig., 541
    - *fulvum* Guiart & Grig., 541
    - *inguinale* Guiart & Grig., 482
    - *lanosum* Guiart & Grig., 542
    - *pubescens* Guiart & Grig., 544
    - *radiolatum* Guiart & Grig., 505
  - *depauperatum* Guéguen, 551
  - *equinum* (Delacroix & Bodin) Guéguen, 468, 537, 539
  - *felineum* Fox & Blaxall, 455-457, 466, 474, 538, 541-543
  - *felineum* Neveu-Lemaire, 497
    - var. *niveum* (Truffi) Dodge, 538, 542
  - *ferrugineum* Ota, 465, 538, 545, 546
    - aleurospores, *454
    - mycelium, 449
    - pedicellate chlamydospores, 452
    - var. Kurotchkin & Chung, 548
  - *flavescens* Horta, 538, 543

Microsporum—Cont'd

  - *fulvum* Uriburu, 466, 468, 469, 502-504, 538, 541, 542
  - *iris* Pasini, 539, 548
    - var. *Craikii* Dodge, 539, 548
  - *japonicum* Dohi & Kambayashi, 473, 539, 546
  - *lanosum* Sab., 469, 537, 542
  - *lanuginosum* Muijs, 538, 544
  - *Malassezi* Baillon, 359
  - *Mansoni* Cast., 678
  - *marginatum* Caz., 537, 540
  - *minimum* Cast. & Chalm., 728
  - *muris* Gluge & d'Ukedem, 555
  - *niveum* Caruso, 542
  - *orientale* Carol, 538, 546, 548
  - *pertenue* Plaut, 551
  - *pubescens* Sab., 468, 538, 544
  - *radiatum* Thomson, 541
  - *Ramos* Parreiras Horta, 540
  - *Ramosii* Parreiras Horta, 537, 540
  - *rubrum* Caz., 537, 539
  - *scorteum* Priestley, 503
  - *tardum* Sab., 550
  - *tomentosum* Pelagatti, 538, 544
    - var. *niveum* Truffi, 542
  - *trachomatosum* Noiszewski, 551
  - *tropicum* Cast., 369
  - *umbonatum* Sab., 539, 549
    - pectinate organs, *450
  - *velveticum* Sab., 550
  - *villosum* Minne, 538, 540
  - *xanthodes* Fischer, 538, 544
  - sp. Bodin & Almy, 542
  - sp. Craik, 548
  - sp. Kambayashi, 546
  - sp. Nakamura, 502
  - sp. Pelagatti, 544
  - sect. Eumicrosporum, 548-551
  - sect. Neomicrosporum, 539-548
- *Microtrichophyton* Neveu-Lemaire, 463, 493
  - *denticulatum* Neveu-Lemaire, 498
  - *felineum* Neveu-Lemaire, 497
- Miliary sebaceous acne, 363
- Milk, 335
- Moeller spore stain, 68, 307
- *Monascus ruber* Tiegh., *610
- *Monilia* Bon., 270
- *Monilia* Gmelin, 143, 166, 207, 216, 270, *271, 325, 438
  - nomenclature, 195, 196
  - *accraensis* Macfie & Ingram, 264
  - *Actoni* Vuill., 146
  - *aegyptiaca* Khouri, 254
  - *africana* Macfie, 262
  - *alba* Cast. & Chalm., 262
  - *alba* Sart., 240
  - *albicans* Auct., 190, 204, 276
  - *albicans* Magrou, 229
  - *albicans* Zopf, 274
  - *Aldoi* Pereira f., 292
  - *alessandrina* Panayotaton, 297
  - *Alvarezsotoi* Mazza & Niño, 177
  - *Pinoyi* Cast. & Chalm., 285
  - *argentina* Vivoli, 291
  - *asteroides* Cast. & Chalm., 218
  - *balcanica* Cast. & Chalm., 249

Monilia—Cont'd
  Balzeri Brumpt, 212
  bethaliensis Pijper, 231
  Blanchardi Cast. & Chalm., 243
  Bonordeni Vuill., 270
  Botrytis Vuill., 297
  brasiliensis Brumpt, 157
  brasiliensis Vuill., 156
  Braultii Vuill., 277
  bronchialis Cast., 246
  bucalis Niño & Puglisi, 176
  Burgessi Cast. & Chalm., 255
  butantanensis Gomes, 244
  candida Bon., 270, 275, 298
  candida Klöcker, 229
  candida Okabe, 174
  candida Plaut, 274
  Caoi Cast. & Chalm., 225
  capsulata Lindner & Knuth, 169, 171
  Castellanii Re, 250
  cornealis Nann., 215
  cutanea Cast. & Chalm., 211
  decolorans Cast. & Low, 253
  digitata Pers., 641
  enterica Cast. & Chalm., 264
  faecalis Cast., 254
  Fioccoi Poll. & Nann., 233
  furfur Vuill., 358
  Guilliermondi Cast. & Chalm., 257
  Harteri Vuill., 178
  inexorabilis Mazza & Palamedi, 242
  inexpectata Mazza, Niño & Egües, 296
  insolita Cast. & Chalm., 258
  intestinalis Ota, 253
  Kochii (Wettstein) Sacc., 272
  Koningi Oud., 645
  Krusei Cast. & Chalm., 231
  laryngitidis Vuill., 344
  londinensis Cast. & Chalm., 252
  Lustigi Cast. & Chalm., 258
  macedoniensis Cast. & Chalm., 259
  macedoniensoides Cast. & Tayl., 253
  macroglossiae Cast., 241
  mannitofermentans Cast., 255
  Mautneri Nann., 298
  metalondinensis Cast. & Chalm., 256
  metatropicalis Cast. & Chalm., 258
  Metchnikoffi Cast., 250
  Montoyai Cast. & Chalm., 298
  Muhira Mattl., 257
  Nabarroi Cast. & Chalm., 253
  Negrii Cast. & Chalm., 253
  nitida Cast. & Chalm., 261
  nivea Cast. & Chalm., 256
  nivea? Macfie & Ingram, 264
  onychophila Poll. & Nann., 294
  parabalcanica Cast. & Chalm., 249
  parachalmersi Cast. & Chalm., 267
  parakrusei Cast. & Chalm., 261
  parapsilosis Ashford, 294
  paratropicalis Cast., 264
  Perieri Cast. & Chalm., 213
  periunguealis Niño, 239
  Perryi Cast. & Chalm., 243
  Pinoyi Cast. & Chalm., 285
  platensis Peruchena, 262
  pseudoalbicans Neveu-Lemaire, 229

Monilia—Cont'd
  pseudoguilliermondi Cast. & Chalm., 256
  pseudolondinensis Cast. & Chalm., 255
  pseudolondinoides Cast. & Chalm., 255
  pseudometalondinensis Cast. & Chalm., 256
  pseudotropicalis Cast. & Chalm., 259
  psilosis Ashford, 205, 279, 283
  pulmonalis Cast. & Chalm., 255
  pulmonalis (Plaut) Sart., 298
  pulmonea Cast. & Chalm., 217
  Richmondi Shaw, 256
  rosea Cast. & Chalm., 293
  rotunda Cast. & Chalm., 220
  rotundata Cast., 220
  rugosa Cast. & Chalm., 219, 225
  Sakuranei Vuill., 679
  Samboni Cast., 298
  sputicola Galippe, 648
  sulphurea Vuill., 228
  Tonge Mattl., 278
  tropicalis Cast. & Chalm., 231, 258
  tropicalis Zepponi, 253
  tumefaciens Poll. & Nann., 232
  tumefaciens alba Ota, 232
  unguis Vuill., 292
  uvae Vuill., 281
  vaginalis Escomel, 298
  vaginalis Mazza & Los Ríos, 243
  zeylanica Cast. & Chalm., 241
  zeylanoides Cast., Douglas & Thompson, 240
  de Forgues Sart., 263
  de Launois et Pinard Sart., 299
  de LeDantec Sart., 238
  sp. Ashford, 279
  sp. Bianchi & Niño, 175
  sp. Brocq-Rousseu, 292
  sp. Cast., 250, 339
  sp. Catanei, 260
  sp. Dübendorfer, 266
  sp. Flu & Woensdregt, 299
  sp. Froilano de Mello, 215
  sp. Jaumain & Colard, 267
  sp. (Cas V) Mattl., 269
  sp. Mazza & Niño, 237
  sp. Pijper, 231
  sp. Swartz, 239
  sp. Talice & Mackinnon, 269
  sp. Williams, 299
Monkey, skin, 477
Monosporella Keilin, 127, 131
Monosporium Bon., 681, 835, 837
  agaricinum Bon., 837
  apiospermum Sacc., 838, *839
    var. *Peperei* Sart., 840
  Magalhaesi (Fróes) Dodge, 841
  sclerotiale Pepere, 840
  spinosum Bon., *838
  tulanense (Cast.) Agostini, 793, 841
    var. *mannitolfermentans* Cast., 841
  venezuelense Cast., 841
Monotosporieae, 668
Mons jovis, 437
Montoyella Cast. & Chalm., 676
  Bodini Cast., 860
  nigra Cast. & Chalm., 676
Moore's method of staining hair and scrapings, 69

Morococcus Sab., 365
Morris method of staining fungi in skin, 68
Mortierella Coemans, 98, 104, 108-110, 118
  Bainieri Cost., 98
  niveovelutina Cif. & Ashf., *105, 118
  polycephala Coemans, 118
  reticulata Tiegh. & Lemonnier, 98
  sp. Cost., 119
Mortierelleae, 99
Mossy foot, 849
Mounting material for study, 66, 67
Moustache, 134
Mouth, 242, 261, 262, 267, 276, 646, 743
Mucedineae, 665, 685
Mucor Mich., 101-103, 108, 110
  Aspergillus Scop., 113
  bifidus Fres., 118
  cornealis V. Cav. & Sacc., 114
  corymbifer Cohn, 112, 114
    typica Lichtheimi Lucet & Cost., 112
  crustaceus L., 641
  dimorphosporus Lendn., *18
  hiemalis Wehmer, *106
  javanicus Wehmer, 98
  Mucedo L., *99, 107, 108
  mycetomi Gelonesi, 860
  niger Ciaglinski & Hewelke, 116
  Prainii Chodat & Nechich, *20
  pusillus Lindt, 111
  racemosus Fres., *18, *20, *106, 110, 118, 859
  racemosus Jakowski, 111
  ramosus Lindt, 111, 113
  Regnieri Lucet & Cost., 114
  rhizopodiformis Cohn, 117
  scarlatinosus Hallier, 110, 111
  septatus Bezold, 117
  sphaerosporus Hagen, 98
  Truchisi Lucet & Cost., 114
Mucoraceae
  classification, 109
  key to pathogenic genera, 110
  morphology, 98-109
Mucoreae, 100, 110
Mucosa, buccal, 176
Mucus, 341
Muguet, 204, 275
Mule, lymphatics, 169
  skin, 169, 540
Muscles, 754
Mycelium, 17
  of Trichophytoneae, *449
Myceloblastanon Ota, 202
  albicans Ota, 274
  balcanicum Ota, 249
  bethaliense Ota, 231
  brasiliense Ota, 157
  bronchiale Ota, 254
  candidum Ota, 270
  Copellii Ota, 252
  cutaneum Ota, 287, 288
    var. Takahashi, 278
  decolorans Ota, 253
  entericum Ota, 264
  enterocola Ota, 245
  faecale Ota, 254
  Favrei Ota, 286

Myceloblastanon—Cont'd
  gifuense Taniguchi, 288
  Gruetzii Ota, 289
  Harteri Ota, 178
  insolitum Ota, 258
  Kartulis Ota, 260
  Krusei Ota, 231
  linguae-pilosae Ota, 260
  londinense Ota, 252
  macedonense Ota, 259
  metalondinense Ota, 256
  Nabarroi Ota, 253
  nitidum Ota, 261
  niveum Ota, 256
  parabalcanicum Ota, 250
  parachalmersi Ota, 267
  parakrusei Ota, 261
  paratropicale Ota, 264
  Pinoyi Ota, 285
  pseudoalbicans Ota, 229
  pseudotropicalis Ota, 259
  psilose Ota, 279
  pulmonare Ota, 298
  roseum Ota, 293
  rotundatum Ota, 220
  tokioense Fujii, 235
  tropicale Ota, 258
  tumefaciens album Ota, 232
  zeylanicum Ota, 241
Mycetoma, 355, 622, 630, 637, 652, 675, 683, 684, 687, 711, 716, 721, 726, 742, 745, 747, 750, 764, 793, 795, 840, 860
  black grain, 680
  pedis, 738, 739, 754, 756, 761, 810
Mycobacterium Lehm. & Neum., 269, 694, 705, 761
  tuberculosis (Koch) Lehm. & Neum., 157, 254
Mycocandida Lang. & Tal., 191, 194, 207, 208, 293, 294
  key to species, 293
  inexpectata Tal. & Mack., 296
  mortifera (Red.) Lang. & Tal., 295
  onychophila (Poll. & Nann.) Lang. & Tal., 266, 293, 294
  parapsilosis (Ashf.) Dodge, 293, 294
  rosea (Zenoni) Dodge, 293
  Skutetzkyi Ota, 293
Mycoderma Pers., 178, 206, 207, 223, 463
  key to species, 223, 224
  nomenclature, 197, 198
  asteroides Brumpt, 218
  Bogolepoffi Jannin, 830
  brasiliense Neveu-Lemaire, 157
  brocianum Pinoy, 209
  Caoi Jannin, 224, 225
  cerevisiae Desmazières, 327
  concentricum Vuill., 490
  cutaneum Brumpt, 211
  dermatitidis Brumpt, 168
  Dombrayi Vuill., 370
  Gilchristi Jannin, 168
  Griewanki Neveu-Lemaire, 214
  histosporocellularis Neveu-Lemaire, 179
  immite Verdun & Mandoul, 149
  infestans Fonseca & Arêa Leão, 209

Mycoderma—Cont'd
  Issavi Mattl., 224, 226
  Kieta Mattl., 224, 226
  Krusei Stovall & Bubolz, 231
  lactis Desm., 287
  matalense Brumpt, 296
  mesentericum Pers., 197, 223
  multifermentans (Cast.) Dodge, 228
  Muyaga Mattl., 224, 225
  nobile Sart., 223, 227
  Nyabisi Mattl., 223, 224
  pararugosum (Cast. & Douglas) Dodge, 219, 224, 225
  pseudoalbicans (Neveu-Lemaire) Dodge, 229
  pulmoneum Vuill., 217
  Rabesalama Font. & Boucher, 236
  Roquettei Vuill., 492
  rotundatum Brumpt, 220
  Sakuranei Jannin, 679
  subtile (Blanch.) Verdun, 228
  sulfureum (Beauverie & Lesieur) Dodge, 223, 227
  vini Grawitz, 274, 275
  virulens (Norris) Dodge, 223, 224
  sp. Bennett, 555
  sp. Griewanki & Laveau, 214
  sp. Sart. & Bailly, 795
Mycoderme LeDantec, 237
Mycogone Link, 853
Mycosis, generalized, 177, 792
Mycosphaerella Fragariae (Tul.) Kleb., *123
Mycotorula Lang. & Tal., 272, *273
Mycotorula Will, 135, 136, 194, 207
  nomenclature, 201
  albicans Lang. & Tal., 178, 274
  albicans Tal. & Mack., 239
  candida Tal. & Mack., 242
  craterica Will, 201
  famata Harrison, 218
  interdigitalis Red., 278
  muris Cif. & Red., 208
  onychophila Ciarrocchi, 294
  pulmonalis Cif. & Red., 217
  radioplicata Will, 201
  vesica Harrison, 236
Mycotoruloides Lang. & Tal., 194, 207, 208, *290
  key to species, 290, 291
  nomenclature, 203
  Aldoi (Pereira Filho) Lang. & Tal., 291, 292
  argentina (Vivoli, Avellaneda & Bardessi) Dodge, 290, 291
  triadis Lang. & Tal., 203, 290, 292
  unguis (Weill & Gaudin) Lang. & Tal., 290, 291
Myxomycetes, 24
Myxotrichum Kunze, 429, 451
Myzeloblastanon (See *Myceloblastanon*)

N

Nadsonia Syd., *127, 165, 307
  fulvescens (Nads. & Konokotina) Syd., *303
  Richteri Kostka, 303
Nails, 234, 239, 248, 266, 267, 291, 294, 296, 315, 440, 479, 500, 523, 524, 549, 622, 625, 627, 637, 638, 645, 647, 649, 673, 825, 830
Naming of organisms, 75-96
Napicladium Thüm., 854
Naso-genal region, 855
Nasopharynx, 151
Neck, 210, 278, 311, 341, 344, 486, 488, 493, 498, 646, 795, 801
Neisseria gonorrhocae (Neisser) Trev., 337
Nematospora Peglion, *127, 130, 136
  Coryli Peglion, *131
  Gossypii Ashby & Nowell, *130
  Nagpuri Dastur, 131
Neogeotrichum Magalhães, 156, 157
  pulmoneum Magalhães, 157
Neomicrosporum Sab. (subgenus), 447, 461, 537, 539, 545
Neotrichophyton Cast. & Chalm., 462
  flavum Cast. & Chalm., 529
  plicatile Cast. & Chalm., 530
Nitrocellulose method for embedding fungi, 71, 72
Nitrogen requirements of fungi, 33, 34
Nocardia Trev., 704, 706
  Actinomyces Trev., 730
  africana Pijper & Pullinger, 754
  alba Froilano de Mello & St. Antonio Fernandes, 725
  albida Chalm. & Christ., 746
  appendicis Chalm. & Christ., 733
  asteroides Blanchard, 750
  aurea Cast. & Chalm., 732
  bicolor Froilano de Mello & St. Antonio Fernandes, 749
  Berestneffi Chalm. & Christ., 754
  bovis Blanchard, 730
  brasiliensis Cast. & Chalm., 749
  Bruni Chalm. & Christ., 752
  buccalis Cast. & Chalm., 755
  candida Cast. & Chalm., 725
  carnea Cast. & Chalm., 741
  Carougeaui Cast. & Chalm., 711
  Chalmersi Froilano de Mello & St. Antonio Fernandes, 734
  Christophersoni Froilano de Mello & St. Antonio Fernandes, 723
  convoluta Chalm. & Christ., 745
  cruoris Macfie & Ingram, 753
  cylindracea Korte, 716
  Dassonvillei (Liégard & Landrieu) Brumpt, 727
  decussata Cast. & Chalm., 760
  enteritidis Cast. & Chalm., 762
  equi Chalm. & Christ., 758
  farcinica Trev., 746
  Foersteri Trev., 713
  Foulertoni Chalm. & Christ., 760
  fusca Cast. & Chalm., 757
  Garteni Goug., 726
  gedanensis Chalm. & Christ., 733
  Genesii Fróes, 761
  goensis Froilano de Mello & St. Antonio Fernandes, 723
  Gruberi Blanchard, 763

- *Nocardia*—Cont'd
  - *Guegueni* Ota, 722
  - *Hoffmanni* Chalm. & Christ., 742
  - *hominis* Cast. & Chalm., 760
  - *indica* Chalm. & Christ., 739
  - *indica* Kanthack, 721
  - *Israeli* Cast. & Chalm., 714
  - *Jollyi* Vuill., 742
  - *Krainskii* Chalm. & Christ., 718
  - *Krausei* Chalm. & Christ., 755
  - *Lanfranchii* Froilano de Mello & Pais, 731
  - *Lasserrei* Verdun, 763
  - *Leishmani* Chalm. & Christ., 740
  - *lingualis* Cast. & Chalm., 722
  - *liquefaciens* Cast. & Chalm., 731
  - *londinensis* Chalm. & Christ., 760
  - *lutea* Christ. & Archibald, 763
  - *luteola* Cast. & Chalm., 732
  - *macrodipodidarum* Fox, 747
  - *Madurae* Blanchard, 739
  - *mexicana* Ota, 721
  - *minutissima* Verdun, 741
  - *mordoré* Chalm. & Christ., 729
  - *Muris* Froilano de Mello, 759
  - *Nicollei* Delanoë, 726
  - *odorifera* Cast. & Chalm., 763
  - *panginensis* Froilano de Mello & St. Antonio Fernandes, 718
  - *Pelletieri* Pinoy, 764
  - *Pijperi* Cast. & Chalm., 756
  - *Pinoyi* Froilano de Mello & St. Antonio Fernandes, 723
  - *pluricolor* Froilano de Mello & St. Antonio Fernandes, 763
  - *pluricolor* Terni, 763
  - *Ponceti* Verdun, 754
  - *pretoriana* Pijper & Pullinger, 747
  - *pseudotuberculosis* Froilano de Mello, 764
  - *pulmonalis* Cast. & Chalm., 758
  - *putridogenes* Froilano de Mello & Pais, 761
  - *Rivierei* Verdun, 721
  - *Rogersi* Froilano de Mello, 764
  - *rosea* Chalm. & Christ., 725
  - *Rosenbachi* Goug., 762
  - *rubea* Chalm. & Christ., 765
  - *rubra* Chalm. & Christ., 718
  - *Sanfelicei* Red., 751
  - *Silberschmidti* Froilano de Mello & St. Antonio Fernandes, 711
  - *somaliensis* Chalm. & Christ., 765
  - *tenuis* Cast., 715
  - *Thibiergei* Cast. & Chalm., 715
  - *Thiryei* Froilano de Mello & Pais, 729
  - *transvalensis* Pijper & Pullinger, 756
  - *valvulae* Froilano de Mello & Pais, 757
  - sp. Lasserre, 763
  - sp. Pijper, 756
- Nodular organs, *450
- Nodules, 233
  - intramuscular, 715
  - subcutaneous, 715
- Nomenclature, botanical, 75-96
- Norris' medium, 54
- Nose, 151, 266, 341, 536, 801, 859
- Nutrition of fungi, 32-34

O

- *Octomyces* Froilano de Mello & Gonzaga Fernandes, 163, 165, 180
  - *Bettencourti* Froilano de Mello & Gonzaga Fernandes, 180
  - *Etiennei* (Potron) Dodge, 180
- *Oedocephalum* Preuss, 824
- Oidial formation, *20
- *Oidiodendron* Robak, 282
- *Oidiomyces unguium* Frei, 287
- *Oidium* Link, 272, 274
  - nomenclature, 196
  - *albicans* Robin, 272, 274
    - var. Galli-Valerio, 259
    - var. Hasegawa, 282
  - *asteroides* Cast. & Chalm., 218
  - *coccidioides* Ophüls, 149
  - *coeruleus cuticularis* Greco, 849
  - *cutaneum* Beurm., Goug. & Vaucher, 211
  - *dermatitidis* Ricketts, 168
  - *epitheliomae* Greco, 536
  - *furfur* Zopf, 358
  - *lactis* Fres., 703
  - *matalense* Cast., 295
  - *porriginis* Mont., 558
  - *protozooides* Ophüls, 149
  - *pulmoneum* Bennett, 217
  - *pulmoneum* Magalhães, 156, 157
  - *Quinckeanum* Zopf, 556
  - *roseum* [*non liquefaciens*] Zenoni, 293
  - *rotundatum* Cast. & Chalm., 220
  - *Schoenleini* Lebert, 558
  - *Schoenleinii* Zopf, 558
  - *subtile* Kotliar, 358
  - *subtile-cutis* Babes, 228
  - *tonsurans* Zopf, 531
  - *tropicale* Cast., 258
  - *Vanderburgii* Kohlbrugge, 244
  - *22* Cao, 225
  - sp. Coley & Tracy, 299
  - sp. Favera, 214
  - sp. Müller & Retzius, 558
  - sp. Sakurane, 679
  - sp. Spiethoff, 270
  - *Stamm I* Gentzsch, 230
- Ointment, Swartz', 472
  - Whitfield's, 472
- *Oleina* Tiegh., 165, 179, 180
  - *lateralis* Tiegh., *165, 179
  - *nodosa* Tiegh., 163, *165, 179
- Onychogryposis, 291
- Onychomycosis, 137, 143, 234, 248, 266, 267, 523, 524, 622, 625, 825, 830 (*see also* Nails)
- *Onygena equina* [Willd.] Pers., 653
- Onygenaceae, 425, 653
- Oogamy, 22
- *Oospora* Sauvageau & Radais, 706
  - *alba* Sart., 744
  - *alba I* Sart., 761
  - *alba* var. *toxique* Sart., 719
  - *algirus* Sart., 682
  - *anaerobies* Sart., 717
  - *asteroides* Sauvageau & Radais, 750
  - *Audouini* var. *equinum* Bodin, 728
  - *aurea* Sart., 732
  - *bahiensis* Sart., 740

Oospora—Cont'd
  bovis Savaugeau & Radais, 730
  brasiliensis Sart., 749
  bronchialis Sart., 757
  buccalis Roger, Bory & Sart., 755
  cameli Mason, 762
  canis Sart., 748
  caprae Sart., 748
  carnea Sart., 741
  catarrhalis Sart. & Bailly, 733
  catenata Schaede, 238
  convoluta Sart., 745
  conzentrica Hanawa & Nagai, 490
  cruoris Sart., 753
  cuniculi Froilano de Mello & St. Antonio Fernandes, 712
  cylindracea Sart., 716
  d'Agatae Sacc., 649
  decussatus Sart., 760
  Dori Sart., 762
  Doriae Sauvageau & Radais, 725
  erysipeloidis Neum. & Lehm., 762
  farcinica Sauvageau & Radais, 746
  forme de Microsporum Bodin, 728
  Forsteri Sauvageau & Radais, 714
  fragilis Schaede, 238
  fusca Sart., 757
  Garteni Sart., 726
  gypsoides Sart., 724
  Hoffmanni Sauvageau & Radais, 742
  indica Kanthack, 739
  Jollyi Sart., 742
  lactis (Fres.) Sacc., 221
  Lasserrei Sart., 763
  lingualis Guéguen, 722
  liquefaciens Sart., 731
  luteola Sart., 732
  Madurae Lehm. & Neum., 740
  mycetomae Sart., 738
  minutissima Ridet, 741
  mordoré Sart., 729
  musculorum suis Lehm. & Neum., 711
  odorifera Sart., 763
  Pelletieri Thiroux & Pelletier, 764
  Perieri Matr. & Antoine, 213
  Ponceti Sart., 754
  porriginis Sacc., 558
    var. *ceratophagus* Sacc., 558
  pulmonalis Roger, Sart. & Bory, 758
    var. *acidoresistant* Sart., 756
    var. *chromogène* Sart., 752
  pulmonea Sacc., 217
  putridogenes Sart., 761
  Rivierei Sart., 721
  rubra Wilbert, 765
  Sommeri Sart., 739
  Spitzi Sart., 752
  spumalis Sart., 751
  Thibiergei Sart., 715
  Tozeuri Nicolle & Pinoy, 681
    var. Brault & Masselot, 682
  valvulas destruens bovis Sart., 757
  sp. Bachmann, 221
  sp. Grütz, 802
  sp. Sart., 712, 715, 719, 722, 730, 735, 756, 758, 765, 766, 795
Oospora Wallroth, 198
Organic compounds, use in sterilization, 46
Osteitis, purulent, 343
Osteoperiosteitis, 183
Otitis, catarrhal, 182
  media, 351
  suppurating, 766 (*see also* Ear)
Otomyces purpureus Wreden, 636
Otomycosis (*see* Ear)
Ovary, 313
Ovularia Sacc., 835
Oxalis tuberosa Molin., 341
Oxygen requirements of fungi, 38, 39

P

Pachybasium Sacc., 841
Paecilomyces Bainier, 642, 646
  type of phialides, *614
  Burei (Poll.) Thom, 642
  Varioti Bainier, 642, *643
Palate, soft, 341
Palmar surfaces, 205, 480, 484, 486, 674, 788
Panki, 736
Papules, 210
Paracoccidioides Almeida, 145-147, 152, 153, 155
  brasiliensis (Splendore) Almeida, 156, 179
Paraffin method for embedding fungi, 71
Paramycetoma, 711
Parasaccharomyces Beurm. & Goug., 207, 265, 266, 342
  key to species, 265
  nomenclature, 200
  albicans Froilano de Mello & Gonzaga Fernandes, 274
  Ashfordi Anderson, 279
  Colardi Dodge, 265, 267
  crateriformis Dodge, 265, 270
  Harteri Froilano de Mello, 178
  intestinalis (Mattl.) Dodge, 265, 268
  irritans (Mattl.) Dodge, 265, 268, 629
  oosporoides (Zach) Dodge, 265, 266
    var. *Guggenheimi* Dodge, 267
  parachalmersi (Cast. & Chalm.) Dodge, 265, 267
  Sambergeri Beurm. & Goug., 200, 265
  subtilis Froilano de Mello & Gonzaga Fernandes, 228
  Talicei Dodge, 265, 269
  zeylanicus Froilano de Mello & Gonzaga Fernandes, 241
  G Nye, 223
Parasitella simplex Bainier, *106
Parasitic achromia, 846
Parendomyces Queyrat & Laroche, 206, 208, 234, 238
  key to species, 239
  nomenclature, 200
  albus Queyrat & Laroche, 200, 238-240
  asteroides Rischin, 210
  Balzeri Goug. & Burnier, 212
  Blanchardi (Cast.) Dodge, 239, 243
  Brocquii Beintema, 210
  butantanensis (Gomes) Dodge, 239, 244
  communis (Cast.) Dodge, 239, 245
  enterocola (Macfie) Dodge, 239, 245
  farciminosus Froilano de Mello et al., 169
  Hessleris (Retger) Dodge, 239, 242

Parendomyces—Cont'd
  inexorabilis (Mazza & Palamedi) Dodge, 239, 242
  Krausi (Ota) Dodge, 239, 244
  macroglossiae (Cast.) Dodge, 239, 241
  minor (Poll. & Nann.) Dodge, 244
  periunguealis (Niño) Dodge, 239
  Perryi (Cast.) Dodge, 239, 243
  pulmonalis Plaut apud Mautner, 298
  rugosus Ota, 219
  Tokishigei Froilano de Mello & Gonzaga Fernandes, 169
  vaginalis (Mazza & Los Ríos) Dodge, 239, 243
  Vanderburgii (Kohlbrugge) Dodge, 239, 244
  Vuillemini (Froilano de Mello & Gonzaga Fernandes) Dodge, 245
  zeylanicus (Cast.) Dodge, 239, 241
  zeylanoides (Cast, Douglas & Thompson) Dodge, 239, 240
  sp. Forgues, 263
  sp. Launois & Pinard, 299
Paronychia, 294, 830
Parthenogamy, 22
Parthenogenesis, 23
Pectinate organs, *450
Pedicellate chlamydospores in Trichophytoneae, *452
Pedogamy, 23
Pelvis, 149
Penicillium Link, 639, 642, 644, 826, 842
  Bertai Tal. & Mack., 639, *640
  Brefeldianum Shear, *616
  brevicaule Sacc., 643, 645
    var. *hominis* Brumpt & Lang., 649
  Burci Poll., 642, 798
  Camemberti Thom, conidial stage, *615
  caseicolum Bainier, conidial stage, *615
  crustaceum [L.] Fr., 641
  epigaeum Motta, 651
  expansum Link, 639
  Giordanoi Vuill., 641
  glaucum Giordano, 641
  glaucum Link, 641
  minimum Siebenmann, 641
  Montoyai Cast. & Chalm., 642
  mycetogenum Mantelli & Negri, 640
  mycetomagenum Mantelli & Negri, 639, 640
  pictor Neveu-Lemaire, 642
  pruriosum Salisbury, 642
  quadrifidum Salisbury, 642
  spiculisporum Lehm., 642
  Wortmanni Klöcker, *618
Penicilliumähnlich Bezold, 641
Penicillus, biverticillate, 614
  definition, 614
  monoverticillate, 614
Penis, 151, 183, 245, 370, 437, 678
Pennsylvania medium, 52
Perianal folds, 278
Pericarditis, 713
Periconia (Tode) Bon., 850
Periconieae, 667, 850
  key to genera, 850
Pericystis Betts, 145
  alvei Betts, 145
Perionychomycosis, 239
Perithecium, 125
Peritoneum, 320
Peritonitis, 254, 750
Perlèche, 176
Pferdehefe II Kraus, 283
Phaeodictyeae, 856
  key to subtribes, 856
Phaeodidymeae, 668
Phaeophragmiae, 853
  key to genera, **854**
Phaeoscopulariopsis Ota, 651
  Bestae (Poll.) Ota, 651
  Paisi (Poll.) Ota, 651
Phaeostilboideae, 858
Pharyngitis, 232, 346
Pharyngolaryngitis, 344
Pharynx, 146, 212, 228, 250, 255, 263, 267, 341, 344
Phata, 736
Phialides, definition of, 613
  types of, *614
Phialophora Thaxter, 833
  verrucosa Pedroso & Gomes, 850
  verucosa Thaxter, *833
Phialophoreae, 667, 833
Phototropism, 40
Phragmospore, 453
Phthisis, 143, 225 (*see also* Tuberculosis)
Phycomyces Kunze, 101, 108
  nitens [Agardh] Kunze, *106, 107, 108
Phycomycetes, 24, 25
Phymatotrichum Bon., 835
Physiology of fungi, 31-40
Physospora Fr., 835
Pichia Hansen, *127, 136
Pichiaceae, 126, 127, 136
Piedraia Fonseca & Arêa Leão, 128, 130, 131
  colombiana Dodge, 133
  Hortai (Brumpt) Fonseca & Arêa Leão, 128, *129, 132
  Sarmentoi Pereira f., 132
  surinamensis Dodge, 133
  venezuelensis Brumpt & Lang., 128, 133
Pilaira anomala (Cesati) Schroeter, 99
Pillars of fauces, 146, 263, 281, 341, 344
Pilobolus Tode, 100, 130
  crystallinus (Wigger) Tode, 101
  microsporus (Klein) Bref., 101
  oedipus Mont., 101
  roridus (Bolton) Pers. ex Fr., 99
Pinoyella Cast. & Chalm., 457, 476
  simii Cast. & Chalm., 476, 477
Pinta, 642, 676
  black, 855
  red, 298
Piptocephalis Bary, 101, 104, 107
  Freseniana Bary, 98
Pirella circinans Bainier, *99
Pityriasis, 541
  alba, 369, 370
  circinata, 361, 760
  flava, 361, 369
  marginata, 760
  nigra, 678

Pityriasis—Cont'd
  rosea, 438, 515
  sicca, 360
  simplex capitis, 361
  steatoides, 361
  versicolor, 358, 361
  versicolor flava, 628
Pityrosporum Malassez, 359
Pityrosporum Sab., 358
  Cantlici Cast. & Chalm., 360
  Malassezi Sab., 359
  ovale Cast. & Chalm., 359
  pachydermatis Weidm., 370
  rhinoserosum Sab., 370
Plantar surfaces, 205, 438, 439, 479, 480, 483, 674, 736, 788
Plasmogamy, 23
Plectascales, 425, 666
Plectenchyma, 18
Pleomorphism in Trichophytoneae, 456, 457
Pleura, 181
Pleuritis, 713
Pleurococcus Beigeli Küchenmeister, 134
Pleurocystis Fresenii Bon., 110
Pleuropneumonia, 263
Pollacci medium, 52, 53
Polyactis Link, 835
Polymorphism, 20, 121
Polyp, 151
Pons, 167
Populus L., 160
Porrigo lupinosa, 440
Posadasia Cantón, 147
  capsulata Moore, 154
  esferiformis Cantón, 148, 149
  pyriformis Moore, 155
Potassium iodide as therapeutic agent, 204
Potato decoction, Talice's, 186
Priestley's method of staining hair and scrapings, 69
Proactinomyces Jensen, 705
Prosenchyma, 19
Prostate, 335, 765
Proteomyces Moses & Vianna, 206, 208, 273, 536
  key to species, 208
  nomenclature, 200
  asteroides (Rischin) Dodge, 208, 210, *211
  Balzeri (Goug. & Burnier) Dodge, 208, 211, 212, *213
  brocianum (Pinoy) Dodge, 208, 209
  Brocquii (Beintema) Dodge, 208, 210
  cornealis (Nannizzi) Dodge, 208, 215
  cutaneus (Beurm., Goug. & Vaucher) Dodge, 211, *212
  Faverae Dodge, 208, 214
  goensis Dodge, 215
  Grieuanki (Neveu-Lemaire) Dodge, 208, 214
  infestans Moses & Vianna, 200, 208, *209
  muris (Cif. & Red.) Dodge, 208
  Perieri (Mat. & Antoine) Dodge, 208, 213
Protococcus nebulosus Kütz., 327
Protomyces Unger, 101
  inundatus Dangeard, 158
Protomyces—Cont'd
  macrosporus Unger, 157, *158, 159
  pachydermus Thümen, 157
Protomycetaceae, 127, 157
Pruritus, 115, 233, 235, 266, 286, 287, 339, 438, 490, 503, 506, 507, 542, 551, 789, 795, 810
  ani, 497, 498
Pseudococcidioides Fonseca, 147
  Mazzai Fonseca, *148, 149
Pseudodysidrosis, 479, 480
Pseudomicrosporon Castellanii Craik, 836
Pseudomixis, 23
Pseudomonilia Geiger, 207, 208, 246, 295
  key to species, 295
  nomenclature, 200
  albomarginata Geiger, 295
  alessandrina (Panayotatou) Dodge, 295, 297
  inexpectata (Mazza, Niño & Egües) Dodge, 295, 296
  matalensis (Cast.) Dodge, 295
Pseudomycoderma Will, 206, 207, 235, 236
  key to species, 236
  nomenclature, 201
  fecale Dodge, 236, 237
  matalense Cif., 296
  Mazzae Dodge, 236, 237
  Rabesalama (Font. & Boucher) Dodge, 236
  Tanakae Dodge, 236, 237
  vesica (Harrison) Dodge, 236
  vini Will 201, 235
Pseudoparenchyma, 19
Pseudopityriasis capitis, 518
Pseudosaccharomyces Laer, 325, 341, 342, 347
Pseudosaccharomyces Bussei Šamberger, 200, 265, 266
Pseudotuberculosis (*see* Tuberculosis)
Psilonia atra Corda, 843
Psoriasis, 115, 244, 340, 489
Pubis, 431, 437
Pubocrural region, 486
Pullularia Berkhout, 672-674
  Jeanselmei (Lang.) Dodge, 675
  pullulans (Bary) Berkhout, 674
Pus, 254, 730, 733
  staining of, 70
Pustules, 210, 233, 266, 351, 486, 505, 518, 735
Pycnia, 19
Pycnospores, 19
Pyemia, 749
Pyrexia, 153, 222, 225, 231, 257, 285, 350, 651
Pyronema confluens (Pers.) Tul., *122, *123

Q

Quercus glandulifera Blume, 288

R

Rabbits, muzzle, 712
Radium, influence on fungi, 40
Râles, 356
Ramulaspora Lindr., 835

Rat, 751
  blastomycosis, 209
  bronchopneumonia, 759
  generalized nodular lesions, 733
  skin, 553
Rat-bite fever, 759
Recovery of organisms, 64, 65
Redaellia Cif., 207, 289
  nomenclature, 203
  elegans Cif., 203, *289
Red flap, 437
Reproductive structures, 19
Respiratory tract, 204, 229, 245, 268, 269, 347
Rheumatism, 713
Rhinoceros, skin, 370
Rhinocladium asteroides Grandinetti, 802
  Beurmanni Vuill., 806
    var. *asteroides* Vuill., 802
  Carougeaui Neveu-Lemaire, 804
  coprogenum Sacc. & Marchal, 800
  Dori Neveu-Lemaire, 762
  Fonsecai Grandinetti, 801
  Gougeroti Verdun, 678
  guayaquilense Valenzuela, 809
  indicum Vuill., 809
  Jeanselmei Grandinetti, 805
  Lesnei Vuill., 809
  parvulum Red., 811
  Schencki Grandinetti, 806
  Schenki Verdun & Mandoul, 806
Rhinosporidium Minchin & Famtham, 147, 151
Rhinosporidium Kinealyi Minchin & Famtham, 151
  Seeberi (Wernicke) Seeber, 151, *152
Rhinotrichum Corda, 786
  asteroides Verdun, 802
  Beurmanni Ota, 806
  Schenckii Ota, 806
Rhizoids, 18
Rhizomucor Lucet & Cost., 115
  parasiticus Lucet & Cost., 115
  septatus (Bezold) Lucet & Cost., 117
Rhizopus Ehrenberg, 98, 101, 110, 111, 115
  key to pathogenic species, 115
  arrhizus Fischer, *18
  Cohnii Berl. & Toni, 117
  equinus Cost. & Lucet, 115, 117
    var. *annamensis* Bernard, 116
  niger (Ciaglinski & Hewelke) Barth., *99, 116
  nigricans Ehrenberg, 98, *106, 107, 115
  Oryzae Went & Gaerl., 98
  parasiticus (Lucet & Cost.) Lendner, *99, 116, 118
  reflexus Bainier, *99
  rhizopodiformis (Cohn), Zopf, 115, 117
Rhodomyces erubescens Apel, 272
  Kochii Wettstein, 272
Rhodotorula bronchialis Lodder, 349
  glutinis Harrison, 351
  mucilaginosa Harrison, 353
    race *rubrorugosa* Lodder, 353
    var. *pararosea* Lodder, 353
    var. *plicata* Lodder, 353
    var. *sanguinea* Lodder, 217
Rhodotorula—Cont'd
  pallida Lodder, 209
  rubra Lodder, 352
  Sannei Lodder, 352
Rhopalomyces Corda, 824
Ringworm, 435, 497, 506
Rooster, 553

S

Sabouraudia Dodge (as subgenus), 445, 524, 525, 527, 528
Sabouraudites Ota & Lang., 463, 537
Sabouraudites (Aleuramma) depauperatum Ota & Lang., 551
  iris Ota & Lang., 548
  lacticolor Ota & Lang., 501
  persicolor Ota & Lang., 486
  Viannai Ota & Lang., 431
Sabouraudites (Aleurocloster) asteroides Ota & Lang., 504
    var. *chibaensis* Ogata, 506
  Audouini Ota & Lang., 549
  caninus Ota & Lang., 509
  farinulentus Ota & Lang., 502
  felineus Lang. & Miloch., 542
  felineus Ota & Lang., 497
  flavescens Ota & Lang., 543
  gallinae Ota & Lang., 555
  granulosus Ota & Lang., 496
  griseus Ota & Lang., 499
  gypseus Ota & Lang., 430, 553
  interdigitalis Ota & Lang., 481
  plurizoniformis Brumpt, 484
  pubescens Ota & Lang., 544
  radiolatus Ota & Lang., 505
  radioplicatus Brumpt, 498
  ruber Ota & Lang., 487
    var. *blanche* Hashimoto, Irizawa & Ota, 500
  scorteus Brumpt, 503
  tardus Ota & Lang., 550
  umbonatus Ota & Lang., 549
  Urenae Ochoterena, 517
  villosus Ota & Lang., 541
  violaceus Ota & Lang., 554
  xanthodes Ota & Lang., 544
Sabouraudites (Closteramma) equinus Ota & Lang., 540
  fulvus Ota & Lang., 541
  lanosus Ota & Lang., 542
  Quinckeanus Ota & Lang., 556
Sabouraud's conservation agar, 51, 52
  glucose agar, 186
  test agar, 52
Saccardaea Cavara, 858
Saccharomyces Meyen, *127, 307, 317
  key to species, 317, 318
  albicans Reess, 274, 275
  anginae Vuill., 317-*319
  annulatus Negroni, 304, 318, 322, *323
  anomalus Hansen, 142
  apiculatus Reess, 341
  Balzeri Cast. & Chalm., 212
  Beauveriei Froilano de Mello, 142
  Blanchardi Guiart, 317, 320
  Breweri Neveu-Lemaire, 338
  Cantliei Cast., 360

Saccharomyces—Cont'd
  capillitii Oud. & Pekelharing, 359
  cerevisiae Meyen, 205, 300, *302, 317
  Chevalieri Guill., 304
  ellipsoideus Hansen, 303, 304
  equi Marcone, 169
  Etiennei Potron, 180
  farciminosus Vuill., 169
  Ferrani Froilano de Mello, 317, 319
  Fresenii Schroet., 345, 351
  glutinis Carbone, 354
  glutinis Cohn, 351
  granulatus Vuill. & Legrain, 317, *318
  granulomatogenes Sanfelice, 339
  guttulatus Winter, 316
  Hagiwarae Dodge, 317, 319
  hominis Cast. & Chalm., 250
  hominis Cost., 338
  hominis Klein & Gordon, 343
  infiltrans Casagrandi, 324
  intertriginis Touraine-Desvaux, 297
  Jadini Sart., 318, 323
  Krusei Cast., 231
  labialis Ribeyro, 318, 322
  Lemonieri Sart. & Lasseur, 317, 318, 321
  linguae-pilosae Lucet, 260
  litogenes Sanfelice, 331
  Mangini Guill., 304
  membranogenes Steinhaus, 344
  neoformans Leopold, 313
  neoformans Sanfelice, 330
  niger Mafucci & Sirleo, 346
  ovalis Bizz., 359
  Pastorianus Hansen, 300
  pseudotubercolaris Santori, 318, 324
  rosaceus Crookshank, 351
  roseus Engel, 348, 351
  ruber Demne, 352
  Samboni Cast. & Chalm., 298
  septicus Gaetano, 340
  sphericus Bizz., 359
  Sternoni Sart., 318, 321
  subcutaneus tumefaciens Curtis, 320
  tumefaciens albus Foulerton, 232
  tumefaciens Cast. & Chalm., 317, 320
  unguium Bourgeois, 248
  (*Willia*) *bispora* Mattl., 143
  Zimmeri Dodge, 317, 318, 321
  sp. Blanchard, 320
  sp. Busse, 343
  sp. Darmagnac & Barletti, 324
  sp. Klein & Gordon, 250
  sp. Plimmer, 331
  sp. Sanfelice, 330
  sp. Sart., 321
  sp. Tanaka, 237
  sp. Tokishige, 169
  sp. Troisier & Achalme, 318
Saccharomycetaceae, 126, 127
  determination of species, 305-307
  general discussion, 301-305
  Imperfectae, 666
    excluded genera, 357
    general discussion, 325
    key to genera, 325
    nomina nuda, 357
  key to genera, 307
Saccharomycete pleomorphus virulens Norris, 224
Saccharomycodes Hansen, 304, 307
  Ludwigii Hansen, 300, *305, 323
Saccharomycopsis Schiönning, 316
  guttulatus (Robin) Schiönning, 298, 300, *316, 342
Saccharomyzetaceen Kartulis, 260
Sadare, 288
Saliva, 253, 258
Salivation, 341
Sapinho, 204, 274
Sarcinomyces Inkin Oho, 860
Sarcoma, 338
Sartorya fumigata (Fres.) Vuill., 634
Sartory's stain, 67
Scaling, 361
Scalp, 360, 361, 502, 542, 557
  infection by Trichophytoneae, 440-448
Scarlatina, 111
Scedosporium Sacc., 837
  apiospermum Sacc., 838
  Magalhaesi Fróes, 841
  sclerotiale Brumpt, 840
  sp. Magalhães, 841
Schizoblastosporion Cif., 203, 206, 207, 234
  globosum (Zach) Dodge, 234
  Starkeyi-Henricii Cif., 203, 234
  tokioense (Fujii) Dodge, 234, 235
Schizomycetes, 24
Schizosaccharomyces Lindner, 307
  asporus (Vorderman) Beijerinck, 301
  hominis Benedek, 308
  mellacei Jörgensen, 301
  octosporus Beijerinck, 300, *301
  Pombe Lindner, 301, 307
Schizotorulopsis Cif., 357
  Alfonsecai Cif., 357
Schoenlinium Achorion Johan-Olsen [Sopp], 558
Schumacher spore stain, 307
Schwanniomyces Klöcker, 127, 142
Sclerotia, 19
Sclerotium Beigelianum Hallier, 134
Scopulariopsis Bainier, 299, 651, 653, 842
  general discussion, 643, 644
  key to pathogenic species, 644, 645
  type of phialides, *614
  americana Ota, 650
  aureus Sart., 645, 648
  Bertacini Red., 644, 646
  Blochi (Mat.) Vuill., 644, 646
  brevicaulis (Sacc.) Bainier, 644
    var. *hominis* Brumpt & Lang., 645, 648
  Castellanii Ota & Komaya, 645, 648
  cinereus Weill & Gaudin, 644, 645
  d'Agatae (Sacc.) Dodge, 649
  Fincki Sart. & Sart., 651
  ivorensis Boucher, 645, 647
  Koningi (Oud.) Vuill., 644, 645
  leproides Leger & Nogue, 848
  lingualis Neto & Martins, 649
  Mencieri Dodge, 645, 648
  minimus Sart., Hufschmitt & Meyer, 645, 647
  Mottai Vuill., 651

Scopulariopsis—Cont'd
  rufulus Bainier, 645
  sehnsuchta Froilano de Mello, 644, 646
  sputicola (Galippe) Dodge, 645, 648
  venerei Greco, 645, 649
  Vignolo-Lutatii (Matr.) Dodge, 650
  sp. Sart., 648
Scrotum, 370, 437, 485, 488, 553, 860
Sebaceous glands, development of, 361-363
Seborrhagia, 361
Seborrhea capillitii, 360, 361
  corporis, 361
  oleosa, 361
  papular, 361
  sicca, 361
Septocylindrium Bon., 859
Serratia marcescens Bizio, 348
Sexual organs of fungi, 21
    of mammals (*see* Genitalia and under individual organs)
Sheep, nasal cavity, 111
  skin, 520, 720
Shoulder, 747
Shrewsbury's cell types in Hansenula, 193
Single cell (spore) cultures, 61
Sinus, 282
Skin, 149, 168, 185, 205, 208-211, 214, 215, 233, 234, 239, 251, 264, 281, 286, 293, 311, 314, 316, 335, 340, 341, 347, 349, 351, 355, 358, 361, 430, 431, 435-440, 478-486, 488-490, 493, 496-500, 502-504, 506-508, 510, 511, 514, 518, 519, 521-526, 529, 531-533, 536, 541-545, 547-551, 553-558, 560, 561, 622, 628, 641, 646, 647, 649, 651, 674, 677-679, 681, 717, 760, 762, 789, 790, 792, 798, 801, 802, 804-806, 809, 810, 824, 829, 832, 833, 835, 837, 838, 843, 844, 847, 849, 855, 859
  glabrous, 500
Skull, base of, 344
Sodoku, 759
Soor, 204, 275
Spermophthora Ashby & Nowell, 130, 137, 146, 156, 453
  Gossypii Ashby & Nowell, 127, *128
Spermophthoraceae, 126, 127, 425
Sphaerotilus bovis Engler, 731
Spicaria Harz, 642, 842
  rubra (Baquis) Dodge, 842, 843
  unguis Weill & Gaudin, 292
Spicularia Pers., 824
Spinal cord, 149
  fluid, 299, 311
Spine, 338
Spinellus fusiger (Link) Tiegh., *106
Spiralia Grig., 463, 493
  asteroides (Sab.) Grig., 493
  mentagrophytes (Robin) Grig., 493, 504
  radiolata (Sab.) Grig., 493, 505
Spirosoma lingualis Migula, 743
Spleen, 153
  enlarged, 153, 722
Spleen medium, Grigorakis', 53
Spondylocladium Martius, 854, 855, 857
  atro-olivaceum Neves, 855
  fumosum Martius, 855
Sporangia, 19, *99
Sporangioles, 104
Sporangiophores, 19
Sporangiospores, 19
Spore, 19
  forms, imperfect, 21
    perfect, 21
    secondary, 21
  shapes in Endomycetales, *127
  stain, Moeller's, 307
    Schumacher's, 307
    Ziehl-Neelsen, 307
Sporendonema Cif., & Red., 182
  epizoum Cif. & Red., 650
Sporendonema Desmazières, nomenclature, 198
  epizoum Corda, 183
  myophilum Peck, 555
Sporobolomyces Kluvyer & Niel, 306
Sporocybe Fr., 858
Sporodinia Link, 101, 108, 113
  grandis Link, *99, *101, *106, *107
Sporodochia, 19
Sporothrix asteroides Davis, 802
  Schencki Hektoen & Perkins, 806
Sporotricheae, 667, 786
  key to genera, 786
Sporotrichopsis Beurmanni Guéguen, 806
Sporotrichosis, 646, 762, 797, 845
Sporotrichum Link, 132, 536, 650, 786
  general discussion, 798-800
  key to species, 801
  pathogenicity of, 800, 801
  asteroides Splendore, 801, 802
  badium Link, 798
  Beurmanni Matruchot & Ramond, 474, 804-806, 827
    var. *asteroides* Beurmann & Gougerot, 802
    var. *indicum* Beurmann & Gougerot, 809
  bombycinum Corda, 805
  bronchiale Montagne, 810
  Carougeaui Lang., 801, 804
  congolense (Baerts) Dodge, 809
  cracoviense Lipiński, 801, 802
    pleomorphism of, 803
  Dori Beurmann & Gougerot, 762
  epigaeum Aschieri, 808
  equi Carougeau, 801, 803
  Fonsecai Pereira f., 801
  Gougeroti Matr., 678
  Grigsbyi Dodge, 801
  indicum Cast. & Chalm., 809
  infestans Sart., 209
  Jeanselmei Brumpt & Lang., 801, 805
  Lesnei (Vuill.) Cast. & Chalm., 809, *810
  lipsiense Benedek, 810
  minutissimum Sacc., 741
  parvulum Brunaud, 811
  Schencki Matr., 474, 800-803, 805
    var. *Beurmanni* (Matr. & Ramond) Dodge, 806, *807

Sporotrichum Schencki—Cont'd
    var. *Fioccoi* Dodge, 808
    var. *Greconis* Dodge, 808
  Schenckii Grigsby & Moore, 801
  sp. Dor, 762
  sp. Gruby, 274
  sp. E. F. Smith, 805
Sporotrichum (*Microsporum*) *Audouini* Sacc., 549
  furfur Sacc., 358
  mentagrophytes Sacc., 504
Sprue, 205, 218, 220, 244, 253, 279, 283
Sputum, 113, 116, 137, 143, 176, 177, 179, 181, 210, 217, 218, 220-222, 224, 225, 229, 231, 237, 241, 244, 245, 249, 253-259, 261, 263, 267-269, 272, 282, 285, 296, 298, 344, 349, 350, 353, 356, 630, 635, 648, 715, 718, 722, 724, 725, 733, 745, 747, 751, 752, 756-758, 760, 794, 795, 798, 831
  staining of, 70
Stachybotrys Corda, 850
Stachylideae, 667
Staining, Amann's solution, 67
  of exudates, 70
  of fungi in skin, Morris method, 68
    Unna's method, 68
  of fungi in tissues, Gram method, 69
    Gram-Weigert method, 69
    Mallory's aniline blue method, 68
  of hair, Adamson's method, 69
    Bachmann's method, 69
    Chalmers & Marshall's method, 69
    Moore's method, 69
    Priestley's method, 69
    Unna's method, 69
  of pus, 70
  Sartory's method, 67
  of scrapings, Adamson's method, 69
    Bachmann's method, 69
    Chalmers & Marshall's method, 69
    Moore's method, 69
    Priestley's method, 69
    Unna's method, 69
  of spores, Gutstein's method, 68
    Maneval's method, 67
    Moeller's method, 68, 307
    Schumacher's method, 68, 307
    Ziehl-Neelsen method, 307
  of sputum, 70
Staphylococcus citreus Passet, 227
Steam, use in sterilization, 47, 48
Steatidrosis, 361
Stemmaria Preuss, 858
Stemphylium polymorphum Hallier, 274
Sterigmatocystis antacustica Cramer, 628
  aurea Greco, 624
  Brodeni Mattl., 635
  cas I, II, IV Mattl., 635
  cas III Mattl., 636
  cas V Mattl., 629
  cinnamomina Weiss, 627
  cyanea Mattl., 636
  fusca Bainier, 625, 626
  gigantea Mattl., 629
  Hortai Lang., 628
Sterigmatocystis—Cont'd
  lutea Tiegh., 625
  nidulans Eidam, 636
    var. *Nicollei* Pinoy, 637
  niger Tiegh., 628
  Phoenicis Pat. & Delacroix, 628
  tropicalis Matta, 639
  tunetana Lang., 635
  unguis Weill & Gaudin, 637
  Vancampenhouti Mattl., 636
  sp. Macfie, 629
Sterilization, 45
  chemical methods, 45, 46
  filtration, 48
  physical methods, 46, 47
  steam, 47, 48
Stilbaceae, 857
  key to genera, 857
Stilbella Syd., 857
Stilbum Tode, 824
Stomata aphthodea, 274
Stomatitis, 249
  creamy, 755
Stools (*see* Feces)
Streptococcus Billr., 298
Streptothrix Cohn, 706
  acido-resistente Sanfelice, 751
  Actinomyces Rossi-Doria, 730
  actinomycotica Foulerton, 730
  alba Bellisari, 744
  alba Rossi-Doria, 725
  alba I Sanfelice, 761
  asteroides Gasperini, 750
  aurea DuBois Saint Sev., 732
  bovis Chester, 731
  bovis communis Foulerton, 730
  brasiliensis Greco, 749
  buccalis Goadby, 731
  cameli Mason, 762
  caprae Silberschmidt, 748
  carnea Rossi-Doria, 741
  Carougeaui Greco, 711
  chromogena Gasperini, 743
  cuniculi Schmorl, 712
  enteritidis Pottien, 762
  Eppingeri Rossi-Doria, 750
  erysipeloides Caminiti, 762
  farcinica Rossi-Doria, 746
  flava Chester, 752
  Foersteri Gasperini, 725, 727, 729
  Freeri Musgrave & Clegg, 742, 750
  fusca Karwacki, 757
  gedanensis I Scheele & Petruschky, 733
  gedanensis II Petruschky, 725
  Hoffmanni Petri, 742
  hominis Foulerton & Jones, 760
  hominis II Foulerton, 760
  hominis III Foulerton, 733
  hominis IV Foulerton, 763
  Israeli Kruse, 714
  Krausei Chester, 755
  Lathridii Petruschky, 725
  lingualis Bajardi, 743
  luteola Foulerton & Jones, 732
  Madurae Greco, 739
  Madurae Koch & Stutzger, 729

Streptothrix—Cont'd
  Madurae Solari, 763
  Madurae Vincent, 739
  micetomae Argentinae α Greco, 739
    var. β Greco, 738
  mineacea Kruse, 718
  Muris-ratti Schottmüller, 759
  mycetomi Laveran, 680, 684
  necrophora Ernst, 713
  necrophora Kitt, 712
  nigra Rossi-Doria, 743
  Nocardii Foulerton & Jones, 746
  odorifera Foulerton & Jones, 763
  pluricliromogène Vallée, 737
  pluricromogena Caminiti, 737
  Putorii Dick & Tunnicliff, 759
  pyogenes Chalm. & Christ., 723
  Rosenbachii Kruse, 762
  rubra Petri, 718
  Somaliensis Miescher, 765
  Spitzi Lignières & Spitz, 752
  Taraxeri-cepapi Schottmüller, 759
  Tarozzii Miescher, 735
  valvulas destruens bovis Luginger, 757
  verrucosa Hübschmann, 738
  verrucosa Miescher, 738
  viridis Lombardo-Pellegrino, 717
  zur-Neddeni Namysłowski, 765
  sp. Aoyama & Miyamoto, 746
  cas I, II Berestnev, 754
  sp. Berardinis, 746
  sp. Berardinis & Donna, 719
  sp. Birt & Leishman, 740
  sp. Block, 739
  sp. Bloomfield & Bayne-Jones, 716
  sp. Caminiti, 724
  sp. Dean, 758
  sp. Donna, 745
  sp. Gaudncheau, 765
  sp. Gibson, 722
  sp. Horst, 749
  sp. Krause, 755
  sp. Loghem, 715
  sp. Neschczadimenko, 712
  sp. Rivière, 721
  sp. Rodella, 734
  sp. Scheele & Petruschky, 733
  sp. Silberschmidt, 711
  sp. zur-Nedden, 765
Stroma, 19
Stylospores, 19
Stysanus Corda, 858
Subcutaneous nodules, 178
Sulphur requirements of fungi, 32
Suspensor, 105
Swartz' ointment, 472
Swine, 115
  lung, 339
  muscle, 711
Sycosis, 135, 312, 435, 448, 498, 508, 523, 526, 527, 531, 544, 553 (*see also* Beard)
Symphosira Preuss, 858
Syncaryon, 23
Syncephalastrum Schroeter, 103
  cinereum Bainier, *103
Syncephalis Tiegh. & Lemonnier, 98, 103
  aurantiaca Vuill., 103
  nodosa Tiegh., 107
Synsporium Preuss, 850
Syphilis, 343, 344, 805, 837
Syringospora Quinquaud, 207, 272, *273, 275, 290
  chlamydospores of, *277
  general discussion, 272, 273
  key to species, 274
  nomenclature, 199
  albicans (Robin) Dodge, 241, 274
  Braulti (Pinoy) Dodge, 273, 274, 277
  Cavarae (Poll. & Turconi) Dodge, 274, 280
  cutanea Dodge, 274, 278
  Hasegawae Dodge, 282
  interdigitalis (Poll. & Nann.) Dodge, 274, 277
  Issavi (Mattl.) Dodge, 274, 280
  Negroni Dodge, 274, 280
  Otae (Nann.) Dodge, 281
  psilosis (Ashford) Dodge, 274, 279, 283
  Robini Quinquaud, 199, 272, 274
  Tonge (Mattl.) Dodge, 274, 278
  uvae (Poll. & Nann.) Dodge, 281

T

Talice's potato decoction, 186
Taphridium Lagerh. & Juel, 157
Taphrina aurea (Pers.) Fr., 160
  bullata (Berk. & Br.) Tul., 160
  Coryli Nish., 160
  deformans (Berk.) Tul., *159
  epiphylla Sadebeck, 160
  Klebahni Wieben, 160
Taphrinaceae, 126, 127, 146, 159
Taraxacum officinale Weber, 157
Tea, 233, 243, 255, 258
  factory cough, 204
  taster's cough, 204
Tear ducts, 714, 765
Temperature requirements of fungi, 39
Temperoparietal region, 500
Tetracytes, 20
Thamnidium Link, 104, 105
  chaetocladioides Bref., 104
  elegans Link, 104
Thielavia basicola Zopf, *613
Thielaviopsis paradoxa (Seynes) Höhnel, *823
Thigh, 115, 167, 228, 270, 321, 431, 437, 485, 553, 726, 750
Thomiella Dodge, 834
  Dessyi (Speg.) Dodge, 834
Thorax, 493, 764, 768, 791
Throat, 146, 263, 311, 319, 341, 344, 860
Thrush, 136, 174, 204, 205, 219, 250, 252, 256, 275
Tibia, 343
Tieghemella Vuill., 113
Tilachlidium Preuss, 858
  Bogolepoffi Vuill., 830, 858
Tinea, 434
  albigena, 788
  axillaris, 289
  barbae, 514, 529

Tinea—Cont'd
  capitis, 503, 517, 522, 524, 527, 529, 530, 535, 548
    infantum, 532
    tropicalis, 431
  cruris, 485, 487, 488, 511
  flava, 361, 369, 648
  imbricata, 436, 490-492
  interdigitalis, 435, 487, 508
  lupinosa, 441
  nigromarginata, 488
  tonsurans, 444-446, 506, 517, 518, 522-526, 530-534, 540
    microsporica, 541, 543-545, 547, 550
  unguium, 440, 549
Toe, 235, 349, 438, 439
Tongue, 116, 238, 242, 250, 252, 253, 257, 260, 285, 291, 292, 341, 649, 722, 760, 803
  black, 338
    pilose, 343
Tonsils, 146, 176, 219, 225, 250, 258, 263, 285, 334, 341, 344, 755, 803
Tooth, roots of, 734
Torula Hansen, 327
Torula Pers., 669, 670, 672
  Bestae Poll., 651
  Jeanselmei Lang., 675
  Mansoni Vuill., 678, 832
  Pais Poll., 651
  Sacchari Corda, 650
Torula Turpin, 326
  botryoidea Chaborski, 357
  cerevisiae Turpin, 326, 327
  epizoa Corda, 183
  glutinis Pringsh. & Bilewsky, 351
  histolytica Harrison, 333
  histolytica Stoddard & Cutler, 337
  Klein Weis, 335
  mucilaginosa Jörg., 353
  Muisa Mattl., 220
  nasalis Harrison, 332
  Plimmer Weis, 331
  Sanfelice Weis, 331
  sp. Frothingham, 337
  sp. Klein, 335
  sp. McGehee & Michelson, 336
  A Starkey & Henrici, 203
Torula meningitis, 327, 329
Torulaspora Lindner, 307
  Delbrucki Lindner, 302
  fermentati Saito, 302
  Rosei Guill., *302
Toruleae, 666, 667, 669
  key to genera, 672, 673
  nomenclature of, 670-672
Torulopsis Berlese, 325, 327, 347, 348
  key to species, 348
  Bernasconi Almeida, 355
  Breweri Almeida, 338
  bronchialis Cif. & Red., 348, 349
  capsulata Almeida, 154
  Castellanii Cast., 250
  cavicola (Artault) Almeida, 348
  conglobata Red., 334
Torulopsis—Cont'd
  Copellii Almeida, 252
  corallina Cif., & Red., 353
  Costantini Almeida, 338
  dermatitidis Almeida, 168
  epidermidis Almeida, 357
  farciminosus Almeida, 169
  fusca Almeida, 355
  glutinis (Fres . ampl. Harrison) Dodge, 348, 351
  granulomatogenes Almeida, 339
  Harteri Almeida, 178
  Hessleri Almeida, 242
  hominis Cast. & Jacono, 343
    var. *honduriana* Cast., 334
  Jeanselmei Almeida, 339
  laryngitidis Almeida, 344
  linguae-pilosae Almeida, 260
  lithogenes Almeida, 332
  macroglossiae Cast. & Jacono, 241
  mena (Font. & Boucher) Dodge, 348-350
    var. *Medundu* (Mattl.) Dodge, 350
  minor Lodder, 244
  Mirandei Almeida, 251
  mitis (Mazza et al.) Dodge, 348, 350
  mucilaginosa (Jörg.) Cif. & Red., 348, 353
    var. *Carbonei* (Lodder) Dodge, 354
    var. *pararosea* (Lodder) Dodge, 353
    var. *plicata* (Lodder) Dodge, 353
  myrmeciae Almeida, 340
  neoformans Lodder, 334
    race *nasalis* Lodder, 332
  neoformans Weis, 330
  Neveuxii Almeida, 330
  niger Almeida, 346
  nitrophila Ashf. & Cif., 354
  ovalis Almeida, 360
  Plimmeri Almeida, 331
  psoriasis Almeida, 340
  pulcherrima (Lindner) Sacc., 278
    var. *variabilis* Lodder, 278
  Rogerii Almeida, 254
  rotundata Red., 333
  rubra (Demne) Almeida, 348, 352
  Sangiorgii Dodge, 348
  Sanniei Cif. & Red., 352, 357
  Tonkini Almeida, 357
Trachoma, 248
Trachytora Sacc. (as subgenus), 182
Transfer of organisms, 57
Trench foot, 645
Trichoderma Pers., 824
Trichogyne, 121
Trichomyces *decalvans* Malmsten, 549
  tonsurans Malmsten, 531
Trichomycosis axillaris
  flava, 715
  nigra, 715
  rubra, 715
Trichophytia maculosa, 547
Trichophyton Malmsten, 147, 429, 439, 444, 445, 448, 461, 462, 476
  description of fungus, 527
    of lesions, 527

Trichophyton—Cont'd
  ectothrix megaspore type, 446
    microspore type, 446
    species, 493
    type, 446-448
  endothrix microide type, 525
    type, 446, 530
  key to species, 527-529
  microide group, 458, 494
    type, 446
  morphology in hair, 446
  neoendothrix type, 446, 447
  section *Endothrix*, 527
    Neoendothrix, 527
  acuminatum Bodin, 440, 445, 456, 462, 468, 532, 534, 678
  acutulum Americo da Veiga, 528, 534
  albiciscans Nieuwenhuis, 440, 788
  album Baudet, 515
  album Sab., 515
  (*Aleurosporia*)
    acuminatum Guiart & Grig., 534
    denticulatum Guiart & Grig., 498
    effractum Guiart & Grig., 532
    plicatile Guiart & Grig., 530
    radians (Guiart & Grig.), 497
    rosaceum (Guiart & Grig.), 510
  amethysticum Williams, 489
  areolatum Negroni, 528, 533
  asteroides Sab., 468, 493, 504, 646
  balcaneum Cast., 518
  bicolor Americo da Veiga, 527, 530
  Blanchardi Cast., 535
  candidum endosporum Rosenbach, 498
  caninum Matr. & Dass., 509
  carateum Brumpt, 536
  Castellanii Brooke, 482
  cerebriforme Sab., 440, 462, 466, 510, 529, 530
  ceroton Caz., 519
  ceylonense Cast., 488
  (*Chlamydoaleurosporia*)
    crateriforme Guiart & Grig., 531
    fumatum Guiart & Grig., 530
    lacticolor Guiart & Grig., 501
    umbilicatum Guiart & Grig., 533
  chosenicum Takahashi, 459, 495, 508
  cineraceum Americo da Veiga, 528, 534
  cinereum Caz., 519
  circumvolutum Sab., 528, 533
  coccineum Katoh, 501, 524
  concentricum Blanchard, 490
  conicum Caz., 521
  coronatum Caz., 520
  crateriforme Sab., 440, 462, 468, 527, 531
    var. *ochropyrraceum* Keller, 529
  Currii Chalm. & Marshall, 431
  decalvans Malmsten, 549
  denticulatum Sab., 454, 493, 498
  depilans Mégnin, 510, 526, 529
  depressum MacCarthy, 459, 495, 507
  discoides Sab., 514
  effractum Sab., 530, 532
  ehimeense Fujii, 506
  epilans Mégnin, 526
  epitheliomae Greco, 536

Trichophyton—Cont'd
  equinum Gedoelst, 510
  erioton Caz., 500
  eriotrephon Papegaaij, 497
  expansum Caz., 520
  exsiccatum Uriburu, 468, 532
  farinaceum album polysporum Rosenbach, 504
  farinulentum Sab., 502
  faviforme album Gregorio, 519
  felineum Blanchard, 454, 493, 497
  ferrugineum Lang. & Miloch., 545
  flavivirens Americo da Veiga, 518
  flavum Bodin, 440, 461, 462, 466, 468, 470, 510, 527-530
    closterospores, *453
    pedicellate chlamydospores, *452
  floreale Caz., 517
  floriforme Beintema, 518
  fuligineum Ogata, 526
  fumatum Sab., 468, 527, 530, 536
  fuscum Dodge, 528, 531
  fuscum sulcatum Neuber, 531
  fuscum tardum Rosenbach, 521
  glabrum Sab., 522
  Gourvili Catanei, 522
  granulosum Kambayashi, 481
  granulosum Sab., 496
  griseum F. Fischer, 499
  griseum Vasconcellos, 499
  gypseum asteroides var. *chilbaense* Ogata, 506
  gypseum Bodin, 455, 463, 467, 493, 504
    var. *asteroides* Auct., 454, 504, 548
      souche R.B.S. Biltris, 553
    var. *granulosum* Sab., 496
    var. *lacticolor* Ballagi, 501
    var. *radiolatum* Bruhns & Alex., 505
    var. *2* Ota, 481
    var. *3* Ota, 481
    var. *C.* Hodges, 440, 481
  gypseum radioplicatum W. Fischer, 498
  holosericum album Rosenbach, 501
  inflatum Fiocco & Minassian, 536
  inguinale Sab., 482
  interdigitale Priestley, 481
    var. *II* Takahashi, 480
    var. *4* Ota, 480
    var. *Kaufmann Wolf* Ota, 481
  intertriginis Sab., 482
  Kagawense Fujii, 506
  lacticolor Sab., 501
  Langeroni Miloch., 525
  lileum Kawasaki, 501, 536
  louisianicum Cast., 535
  luxurians Brault & Viguier, 519
  Macfadyeni Cast., 369
  Mansoni Cast., 490
  marginatum Muijs, 524
  megalosporum endothrix Sab., 531
  Megnini Blanchard, 510, 554
  mentagrophytes Gedoelst, 463, 468, 504
    var. *asteroides* Neveu-Lemaire, 504
    var. *granulosum* Neveu-Lemaire, 496
  microsporum Sab., 549
  minimum LeCalve & Malherbe, 728

Trichophyton—Cont'd
  multicolor Magalhães & Neves, 500
  niveum Hodges, 480
  niveum Sab., 493, 497
    var. *denticulatum* Sab., 498
    var. *radians* Sab., 497
  nodoformans Cast., 511
  ochraceum Sab., 521
  ochropyrraceum Muijs, 527, 529
  papillosum Lebasque, 515
  pedis Ota, 472, 479, 480
    var. *β* Ota, 487
  persicolor Sab., 440, 486, 494
  pilosum Sab., 535
  planum fuscolargum Rosenbach, 520
  plicans fusisporum Rosenbach, 530
  plicatile Sab., 440, 468, 527, 529
    pedicellate chlamydospores, *452
  polygonum Uriburu, 528, 532
  propellens leptum Rosenbach, 502
  pruinosum Catanei, 520
  purpureum Bang, 485
    var. *I* Takahashi, 480
    var. *II* Takahashi, 486
  radians Sab., 497
  radiolatum Sab., 454, 505, 548
  radioplicatum Bruhus & Alex., 498
  regulare Sab., 528, 532
  rodens Paul, 496, 507
  rosaceum Sab., 467, 510
  roseum Bodin, 510
  rotundum MacCarthy, 528, 533
  rubidum Ota, 484
  rubidum Priestley, 486, 501
  rubrum Semon, 487
  Sabouraudi Blanchard, 440, 445, 456, 462, 468, 469, 527, 528, 534
    var. *pilosum* Dodge, 528, 535
  Sabouraudi Cast., 535
  singulare Caz., 515
  soudanense Joyeux, 529, 535
  spongoides Fiocco & Minassian, 536
  sudanense Bruhns & Alex., 535
  sulfuratum Bessunger, 531
  sulfureum Sab., 468, 528, 529, 531
  tonsurans Friedberger, 542
  tonsurans Malmsten, 437, 440, 446, 462, 468, 469, 523, 527, 528, 530-533
    aleurospores, *454
    arthrospores, *451
    closterospores, *453
    intercalary chlamydospores, *452
    var. *effractum* (Sab.) Dodge, 528, 532
    var. *exsiccatum* (Uriburu) Dodge, 532
  umbilicatum Sab., 528, 533
  umbonatum Americo da Veiga, 534
  verrucosum Bodin, 522, 525
    var. *asini* Neveu-Lemaire, 526
  Viannai Froilano de Mello, 431
  vinosum Sab., 511
  violaceum Kusunoki, 554
  violaceum Sab., 440, 467, 523
    var. Ballagi, 524
    var. *khartoumense* Chalm. & Macdonald, 523
Trichophyton—Cont'd
  à culture jaune craquelée, vermiculaire Sab., 529
  à culture rose Sab., 510
  à culture violet foncé Sab., 523
  à cultures acuminées Sab., 534
  cas du Horta Ota & Lang., nodular organs, *450
    pectinate organs, *450
    pedicellate chlamydospores, *452
  du cheval à cultures blanches Bodin, 504
  du chien Sab., 553
  faviforme à culture brune du cheval Bodin, 522
  faviforme à culture grise [*de l'âne*] Bodin, 525
  germen I Gregorio, 531
  germen II Gregorio, 522
  megalosporon pyogène du cheval Sab., 504
  pyogène à cultures blanches Sab., 497
  sp. Ceresole, 508
  sp. Darier, 536
  A, *B* Hodges, 440
  C Hodges, 440
  sp. Kaufmann-Wolf, 480
  sp. Matr. & Dass., 509
  sp. Sab., 482, 502, 531, 532
Trichophytoneae, 425, 668
  allergy, 474-476
  characters of giant colonies, 449
  classification, 462-464
  geographic distribution, 465, 466
  immunology, 474-476
  key to genera, 476
  lesions, 434-449
  morphology, 449-455
  mutants, 455, 456
  pathogenicity, 435
  phylogeny, 457-462
  physiology, 466-471
  pleomorphism, 456, 457
  therapeusis of infections by, 474
  variations in, 455, 456
Trichosporieae, 668
Trichosporium Fries, 132, 786, 791
  key to species, 791
  asteroides Bolognesi & Chiurco, 210
  Clapieri (Catanei) Dodge, 794
  Gammeli (Poll. & Nann.) Dodge, 791, 792
    var. *lanuginosum* (Cast.) Dodge, 792
  Graphii (Harz & Bezold) Dodge, 791, 793
  khartoumensis (Chalm. Arch.) Dodge, 791, 793
  Mantegazzae Poll., 651, 791
  Pedrosoanum Ota, 850
Trichosporon Behrend, 131, 132
  Balzeri Ota, 212
  ovoides Behrend, 135
  Perieri Ota, 213
Trichosporum Vuill., 131-133, 136
  Asahii, 233
  Balzeri Bolognesi & Chiurco, 212
  Beigelii (Rabenh.) Vuill., 134
  cutaneum Ota, 211
  equinum Fambach, 136
  Foxi Cast., 136

Trichosporum—Cont'd
  giganteum Unna, 133, 135
  glycophile DuBois, 135
  Hortai Brumpt, 132
  ovale Unna ap. Vuill., 134, 135
  ovoides Behrend, 135
  rugosum Ota, 219
Trichothecium Link, 851, 853
  roseum Link, *852
  sp. Neumann, 741
Trigonopsis Schachner, 357
  variabilis Schachner, 357
Trunk, 506
Trychophyton cruris Cast., 482
Tuberculariaceae, 858, 859
Tuberculosis, 153, 157, 167, 179, 204, 217, 225, 244, 256, 258, 262, 264, 292, 330, 333, 335, 343, 344, 622, 630, 634, 635, 639, 641, 722, 725, 750, 756, 757, 765, 803, 811
  pulmonary, 269
Tumor, 214, 227, 277, 320, 327, 338, 635, 643, 681, 682, 764, 794, 798, 806, 833
Turkey, 324
  skin, 555

U

Ulcer, 168, 173, 208, 209, 211, 214, 228, 233, 235, 242, 282, 296, 335, 349, 355, 536, 639, 646, 649, 678, 766, 790, 804, 828, 829, 837, 846, 847, 850
  cutaneous, 341
  gingival, 761
  nodular, 341, 344
  tongue, 291
Ulcus interdigitale, 736
Uncigera Sacc., 842
Unna's method of staining fungi in skin, 68
  hair and scrapings, 69
Urethritis, 859
Urine, 177, 230, 270, 352
Ustilago Phoenicis Corda, 628
Uvula, 146, 151, 281

V

Vagina, 240, 243, 252, 253, 256, 276, 347, 853
Venereal granuloma, 649
Vertebrae, 227
Verticellium depauperatum Bruhns & Alex., 548
Verticillieae, 667, 841
  key to genera, 841, 842
Verticilliopsis Cost., 841
Verticillium Nees, 359, 841, 842
  agaricinum (Link) Corda, *842
  Graphii Harz & Bezold, 793
  rubrum Baquis, 843
Vesica urinaria, 642
Vibrio lingualis Weibel, 743
Vital staining of fungi, 70
  Dalmau's method, 70
Vitamin requirements of fungi, 34
Vitiligo, 723
Volkartia R. Maire, 159
Vulva, 281, 642

W

Warts, 340, 849, 850
  seborrheic, 361
Water requirements of fungi, 31, 32
Weasel, bite of, 759
White head, 443
Whitfield's ointment, 472
Willia Hansen, 142
  anomala Hansen, 142
    var. Beauverie & Lesieur, 142
Williopsis Zender, *127, 142, 304
  saturnus (Klöcker) Zender, 141, 304, 323
Witkop, 443, 561
Wool, lumpy, 720
Wounds, 213, 218, 227, 242, 648, 649, 652, 808, 828
Wrist, 687

Z

Zeugites, 24
Ziehl-Neelsen spore stain, 307
Zoogloea Beigeliana Eberth., 134
Zygophores, 105
Zygopichia Klöcker, 136
  Chevalieri (Guill.) Klöcker, 304
Zygorrhynchus Vuill., 101, 108
  Dangeardi Moreau, 108
  heterogamus Vuill., *106
  Moelleri Vuill., 107
Zygospores, *106
Zygosaccharomyces Barker, 301, 307
  Chevalieri, Guill., *301
  mongolicus Saito, 302
  Priorianus Klöcker, 300
Zygotes, 20
Zymonema Beurm. & Goug., 165, 180, 208, 223, 346, 536, 651
  general discussion, 165, 166
  key to pathogenic species, 166
  nomenclature, 199
  albicans (Okabe) Dodge, 166, 174
  album Dodge, 166, 175
  Alvarezsotoi (Mazza & Niño) Dodge, 166, 177
  bonaerense (Greco) Dodge, 166, 175
  brasiliense Splendore, 156
  bucale (Niño & Puglisi) Dodge, 166, 176
  capsulatum (Dodge & Ayers) Dodge, 162, *163, 166, 167, 299, 341
  crateriforme (Hudelo, Sart. & Montlaur) Dodge, 166, 174
  Cruzi (Froilano de Mello & Paes) Dodge, 166, 176
  dermatitidis (Gilchrist & Stokes) Dodge, 162, *164, 166, 168, 178, 214, 215, 242, 244, 299
  farciminosum (Rivolta) Dodge, 166, 169, 251, 298, 803
  Gilchristi Beurm. & Goug., 168, 199
  Harteri (Verdun) Dodge, *178
  histosporocellularis Haverfeld, 179
  immite Froilano de Mello & Fernandes, 149
  Molardi (Salvat & Fontoynont) Dodge, 166, 173
  pulmonalis membranogenes Martin, 222
  Sakurani Beurm. & Goug., 199